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MARCH-APRIL 1960

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The members of this Association, mindful of the vital importance to national defense of chemistry, allied sciences, and the arts derived from them, have joined together as a patriotic obligation to preserve the knowledge of, and interest in, national defense problems derived from wartime experience; to extend the knowledge of, and interest in, these problems; and to promote cooperative endeavor among its members, the Armed Services, and civilian organizations in applying science to the problems confronting the military services and other defense agencies, particularly, but not exclusively in fields related to chemical warfare. (From Art. II, AFCA Constitution.)

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POLICY

The fact that an article appears in this magazine does not indicate approval of the views expressed in it by any one other than the author. It is our policy to print articles on subjects of interest in order to stimulate thought and promote discussion; this regardless of the fact that some or all of the opinions advanced may be at variance with those held by the Armed Forces Chemical Association, National Officers, and the Editors. It is the responsibility of contributors, including advertisers, to obtain security clearance, as appropriate, of matter submitted for publication. Such clearance does not necessarily indicate indorsement of the material for factual accuracy or opinion by the clearing agency.

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COVER PHOTO

Delaware Air National Guard drops fire-bombs at Army Chemical Center, Maryland, in training exercise arranged as matter of mutual benefit at request of the Chemical Corps, which was thus facilitated in obtaining some up-to-date action photos needed for its traveling exhibit.

PHOTO CREDITS

All U.S. Army except as here noted, or in article. Pages 2, 3, 4 (lower right), 30 (upper right), 31 (Rosenfeld) Photographer not indicated; page 4 (group) by Lt. Col. John F. Carroll, USAR.

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A.F.C.A. AFFAIRS

ANNUAL MEETING PLANS

Preliminary actions have been taken by the Executive Committee of the National Organization and also that of the Washington Chapter, toward development of plans for the Fifteenth Annual Meeting of the Association, to be held in Washington, D. C. September 15-16 at the Sheraton-Park hotel.

In accordance with established procedure of rotation of "host services" it is planned that the meeting this year will be principally supported by the U. S. Air Force. The last meeting hosted by the Air Force was that held in the Nation's Capital also in 1957. For that meeting there was an extensive open program supplemented by classified presentations conducted at Andrews Air Force Base.

Rear Admiral M. P. Hottel USN (Ret), Manager of the Washington Office of National Lead Company, at 1025 Connecticut Avenue, Northwest, Washington, D. C., has accepted the chairmanship of the Committee on Arrangements for the meeting this year.

A.F.C.A. SURVEY COMMITTEE APPOINTMENTS ARE MADE

Colonel Chenery Salmon, of Boston, Chairman of the A.F.C.A. Committee to survey and report upon the affairs of the Association (as announced in the January-February issue of THE JOURNAL) has appointed the following additional members of the Committee who have agreed to serve:

Colonel R. E. Baker, Petrochemical Department, Continental Oil Company, Houston, Texas.

Mr. William T. Cofer, Jr., Manager Defense Products Department, Mine Safety Appliances Company, Pittsburgh, Penna.

Mr. Helge Holst, Treasurer, Arthur D. Little, Inc., Cambridge, Mass.

Mr. James Sheridan, Treasurer, Allied Chemical Corporation, New York, N. Y.

DOW BOARD CHAIRMAN HONORED ON 60TH YEAR WITH COMPANY

An 80th birthday and a 60-year career with a single company was observed at Midland, Michigan, on January 18 for Dr. Earl W. Bennett, chairman of the board of The Dow Chemical Company.

Some 150 guests from all parts of the country attended a testimonial dinner at the Midland Country Club, honoring the man who began his career with Dow as office boy in 1900 and for many years served as its chief financial officer.

A highlight of the program was the presentation of a folio of about 250 congratulatory letters and messages to Dr. Bennett from friends located throughout the country and abroad.

EDITORSHIP OF THE JOURNAL

The Executive Committee, at its meeting in Washington, D. C., January 25, 1960, accepted with expressions of reluctance and regret and a rising vote of appreciation of his services, the decision of Colonel John C. MacArthur, USA-Ret, to relinquish the editorship of the Armed Forces Chemical Journal, a position which he has held since July 1953.

Following laudatory comments on his editorship by individual members, the Committee, by unanimous vote, directed that the Editor's decision be accepted and that the sentiments of the Committee, in appreciation of his services as expressed by the members present, be embodied in suitable resolutions and that same be given appropriate publication. The Committee noted that the retirement of Colonel MacArthur from the editorship, which was announced at this meeting by President Sayre, was not a matter of sudden decision, the Committee having for some time, been informed of this intention.

General Sayre noted that Colonel MacArthur would continue to serve through the publication of the March-April issue of THE JOURNAL. By mutual agreement this was subsequently extended to the May-June issue.

S. A. MATTISON NEW PRESIDENT OF WASHINGTON, D. C., CHAPTER

Mr. S. A. Mattison, representative of the Hooker Chemical Corporation, with offices at 801 19th Street, Northwest, Washington, D. C., has been elected President of the Washington Chapter of A.F.C.A., succeeding Mr. L. Douglas Weiford, of the Stauffer Chemical Company, with offices at 1612 K Street, Northwest, Washington, D. C.

Other new officers of the Chapter recently elected are the following: 1st Vice President, Mr. Charles E. Pledger, Jr., 512 Washington Building, Washington, D. C.; 2nd Vice President, Mr. R. T. Norman, Little Farm, Chain Bridge Road, McLean, Virginia; and Secretary-Treasurer, Mr. Carroll W. Hayes, Celanese Corporation of America, 1026 17th Street, Northwest, Washington, D. C.

The new year for the Chapter was inaugurated on January 26 with a reception and buffet dinner at the Army and Navy Club, Washington, D. C. Some hundred members and their wives were present.

C. J. B. HARDY OF PINE BLUFF ATTENDS EXECUTIVES MEETING

Mr. Conrad J. B. Hardy, president of the Pine Bluff Arsenal Chapter, A.F.C.A., was one of the seventy Army military and civilian executives from Kansas, Colorado, Texas, Arkansas, Louisiana, Oklahoma and New Mexico named to attend an eight-day Department of the Army personnel management for executives conference, which opened at Fort Sam Houston, Texas, on January 20.

H. A. KUHN
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Reports • Surveys
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GEORGE W. PERKINS

Mr. George W. Perkins, a member of A.F.C.A., distinguished for accomplishments in both industry and government, died at his home in New York City on January 10 following a heart attack. He was 64.

Among the many members and former members of the Army Chemical Corps with whom he served in World War II, or who otherwise knew him, Mr. Perkins is perhaps best remembered as Colonel Perkins, Chief of the Field Requirements Division in the Office of the Chief of the war-time Chemical Warfare Service, as the Corps then was called. In this broad assignment his main post of duty was in Washington, D.C., but his work involved extensive visits to overseas theatres of operations including the Far East and Europe. He was awarded the Legion of Merit.

After the war Mr. Perkins returned to Merck & Co., with which firm he had been connected since 1927 and in which he held top executive positions of treasurer and executive vice president.

However, he was soon called back to government. In 1948 he was appointed Director of the Industry Division of the Economic Cooperation Administration in Paris. In 1949 he was appointed Assistant Secretary of State for European Affairs, and served in that capacity into 1953. In 1955 he was again called to government service, this time as U. S. Permanent Representative in Paris to the North Atlantic Treaty Organization with the rank of Ambassador. He resigned that office in 1957.

Mr. Perkins was born at Riverdale-on-Hudson, N. Y., May 2, 1895. He was a graduate of Princeton, and had also a Master's degree from Columbia University. In World War I he served overseas in the 1st Division as Private, Regimental Supply Sergeant, and, later, as 2d Lieutenant of Field Artillery.

The Department of State issued a statement on January 11 expressing the Department's regret in the death of Mr. Perkins and quoting Acting Secretary of State Livingston T. Merchant, as follows:

"The many friends who worked with George Perkins both in the Department and during his later assignment to NATO in Paris were deeply grieved at his passing. His warm and human relationship with his associates and his understanding and sympathetic approach to the problems with which he dealt left a deep impression upon all those who worked with him. We all feel a personal sense of loss at his passing and extend to his family our deepest sympathies on their bereavement."

COL. JOSEPH F. ESCUDE

Colonel Joseph F. Escude, 50, a native of Jersey City, N. J., died Monday, January 25, at Walter Reed General Hospital, Washington, D. C. He was admitted to the hospital on January 20.

A graduate of Seton Hall in New Jersey and of La Salle Military Academy at Long Island, N. Y., Colonel Escude entered on active military service in January 1942. He was a charter member of A.F.C.A.

From 1948 to 1954, he was commanding officer of the New York Chemical Procurement District in New York City.

Other key assignments he held included more than eight years in the Office of the Chief Chemical Officer, Washington, D. C., as assistant chief and later chief of the Fiscal and Planning Division from 1942 to 1947, and, from 1954 to 1957, as chief of the Purchasing and Contracting and Materiel divisions. His last assignment was as Chemical Officer, Headquarters, U. S. Army Caribbean, Ft. Amador, Canal Zone.

He was well known in Washington as chairman of the Touchdown Club dinners and for his work with the Police Boys Club. He was credited with originating the idea for the All-High football tournaments held in this area yearly.

In 1946, he was awarded the Legion of Merit. Colonel Escude also received the Army Commendation Ribbon with two oak leaf clusters, the World War II Victory Medal, American Campaign Medal, Armed Forces Reserve Medal, and National Defense Service Medal.

The funeral, with full military honors, was at Fort Lee, Virginia, with burial at Madonna Cemetery there.

NEW YORK CHEMICAL OFFICERS HONOR GENERAL SAYRE

Examining the plaque presented to Brig. General Clifford L. Sayre at New York Chemical Officers dinner in his honor at Governors Island, N. Y., are: (l to r) Colonel Leonard Miller, Commanding Officer, N. Y. Chemical Procurement District; Colonel Claude Merrill, Personnel Officer, Office Chief Chemical Officer, Washington, D. C.; General Sayre; Colonel Frank McGuane, Commanding Officer Chemical Corps Troop Units, First Army Area; and Colonel Theodore P. Gahan, Chemical Officer, First Army (who made the presentation).

A plaque inscribed "From the Chemical Officers—Greater New York Area" was presented to Brig. Gen. Clifford L. Sayre at a dinner held at Fort Jay, Governors Island, N. Y., incident to his recent retirement from the Active Army Reserve.

General Sayre, who is head of Central Engineering of the Chemical Division, Food Machinery and Chemical Corporation, will complete his second term as President of A.F.C.A. this Spring.

W. L. RIPPETEAU, JR. NAMED CHEMICAL ADVISER FOR BSDA

W. L. Rippeteau, Jr., of the Wyandotte Chemicals Corporation, on January 7, was named Adviser to the Director, Chemical and Rubber Division, Business and Defense Services Administration, U. S. Department of Commerce.

Mr. Rippeteau, who is manager, organic chemicals, for Wyandotte, comes to BDSA under an arrangement by which industry makes executive personnel available for temporary assignment without compensation from the Government. The service also equips him for membership in the National Defense Executive Reserve.

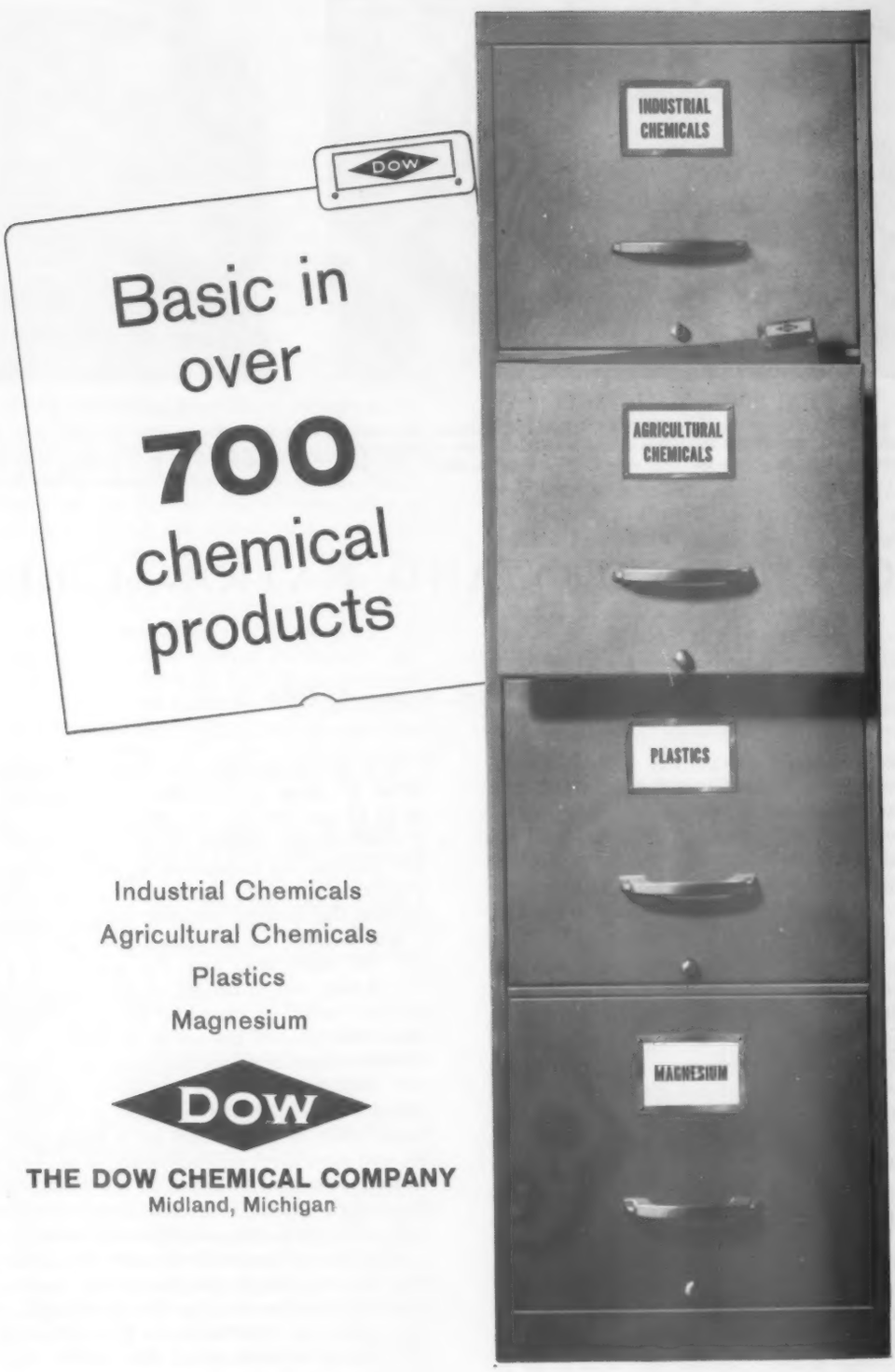
Mr. Rippeteau, 43, was graduated from the University of Kansas in 1939 with a B.S. degree in chemical engineering. He then joined the research department of Phillips Petroleum Company for a short period, before entering the Army as a second lieutenant. He spent four years in the Office of the Chief, Chemical Corps, in various capacities and was discharged as a major. Mr. Rippeteau returned to Phillips Petroleum briefly before joining Wyandotte in 1947. He is a member of A.F.C.A.

"SID" KIRKPATRICK RETIRES

The cover of the December 28 issue of *Chemical Engineering* carries a portrait in color of Dr. Sidney D. Kirkpatrick, along with the formal announcement of his retirement as Editorial Director of *Chemical Engineering* and *Chemical Week*. In the same issue there is an account of the presentation of the first Kirkpatrick Award, established by the two publications over which Dr. Kirkpatrick has so long presided.

The high lights of the career of our fellow editor is covered not only in this issue of *Chemical Engineering* but in numerous other publications available to THE JOURNAL'S readers. We wish to pay tribute to Sid because of his many services to the chemical and chemical engineering professions, and particularly to the Armed Forces Chemical Association as a Director. We welcome him to the ranks of active and useful retirees who enter into a broader career of service to their professions as well as a well deserved relaxation and freedom to work or play as one's feelings and state of health dictate. This is a very distinguished company of which Dr. John Van Noostrand Dorr is the dean.

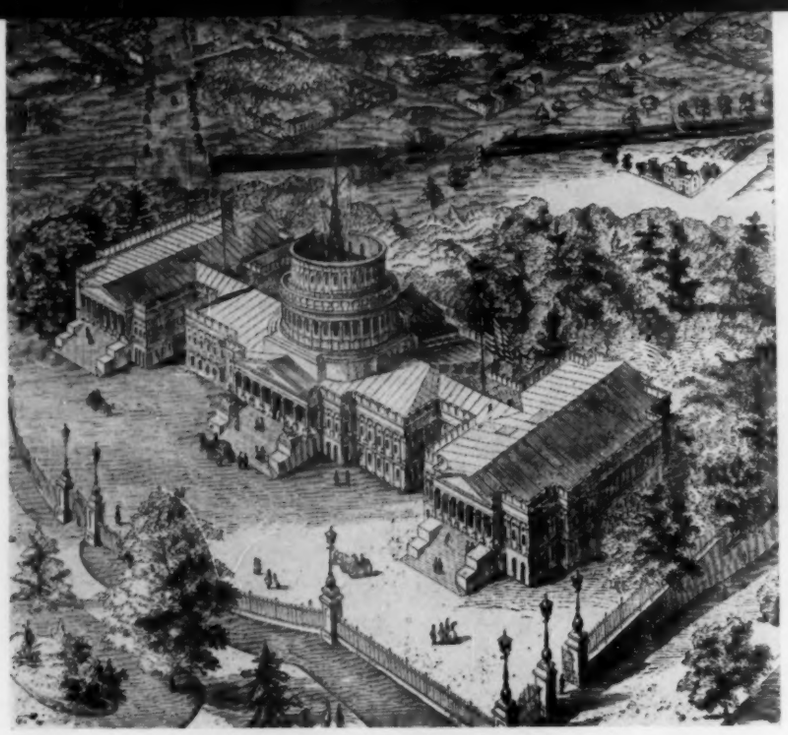
—W. T. Read, Sr.



Industrial Chemicals
Agricultural Chemicals
Plastics
Magnesium

DOW

THE DOW CHEMICAL COMPANY
Midland, Michigan



CAPITOL MAY 1861

Reproduced from an engraving of the uncompleted Capitol, published in 1866 in Harper's Pictorial History of The Great Rebellion which was made from a photograph taken from a balloon in 1861. It shows the east side of The Capitol, which was then the front.

CAPITOL JAN. 1960

This Washington Evening Star photograph of the status of the current extension of the east side was published in The Evening Star on January 7, 1960 and is reproduced here by permission.

CHEMICAL INDUSTRY AND NATIONAL DEFENSE

By HARRY A. KUHN, Colonel USA (ret.)

CURRENT ALTERATIONS to the Capitol in Washington, D. C., now well advanced, will extend the East wall forty feet and thus, among other results, place the dome in the center of the building. But while it has taken a hundred years to bring this about, as may be seen from the pictures herewith, it did not require a hundred years to demonstrate that the chemical industry is in the center of our national defense.

The central position which industrial chemical resources have now come to occupy in the structure of our national defense is not static, or fixed for all time. It is not something which once having been achieved can be taken for granted as needing no further nurture for its maintenance. Indeed, constant attention must be given to this ever-changing industrial foundation for defense, and provisions made in planning and preparedness effort for its expansion and growth as necessary.

The dependence of our past military defense on the chemical industry can be dated from colonial days rather than the past century since the manufacture of saltpeter and gunpowder began here soon after the Pilgrims landed. Wood ashes, the principal world source of potash, was one of our first chemical raw materials.

Potash, derived from *ashes* and the iron *pot* in which the water extract was boiled, was not only the basis of our soap, glass and gunpowder industry but was our principal chemical export to England. The Census of 1860 indicates that 3450 men were employed in the production of potash in a large number of small plants.

It is interesting to note that on January 3, 1860, the price of *ashes, pot,* 63/66%, was quoted at New York at $5.15 per 100-lbs. in 500 pound barrels. On January 4, 1960 *caustic potash,* 88/92%, was quoted at $8.70 per 100 pounds, an indication of the manner in which improved technology in the chemical industry has improved the quality without increasing the price.

Wood ashes, accumulated in large quantities in clearing the land, was also the source of a high potency liquid soap which did all of the things claimed for some of the "new" detergents being promoted today. The housewife placed the ashes in a large barrel containing a crude filter of straw and with a bung hole in the bottom. Rain water was poured over the ashes, a little lime was added and then the liquid was withdrawn from the bung hole. It was boiled in a large iron pot with hog fat and suet until saponification was completed. The resulting detergent, diluted, in the family wash would remove dirt, grease and color from the grimiest overalls and, undiluted, dissolve the hair from a dead hog.

Another early chemical asset of military importance was the manufacture of sulphuric acid which began in this country shortly after the Revolution. By 1860 there were plants in operation in Pennsylvania, New Jersey and Massachusetts using the pyrites chamber process developed in England. One is impressed, in view of the primitive methods of lead burning, by the size of the lead chambers, 50 feet by 18 feet by 18 feet. The dilute acid was concentrated in platinum-iridium stills encased in cast iron—a most *modern* item. The annual capacity of sulphuric acid in the Civil War was 40 thousand tons per year; jumped from 5 million tons in

*Article based on a talk to the Chemical Engineers Club of Washington, D. C.

1940 to 18 million tons in 1945, and it is almost 23 million tons now.

Although little data is available on the capacity of the 84 individual small chemical plants, the Census of 1860, listing workers by occupation and location, includes 508 chemists of which 158 were in New York, 147 in Pennsylvania, 77 in Massachusetts and 36 in New Jersey. We may assume these states were the chemical centers of the time, although there were a number of plants listed in the Middle West. Incidentally, this Census lists a total of 27,000 civil and mechanical engineers, another most valuable military asset in the Civil War.

In 1860 there were 15 gunpowder plants in the North employing over 23,000 men. The largest plants were located at Wilmington, Delaware; Hazardville, Connecticut, and South Windham, Maine. These plants, using potassium nitrate imported from England, or obtained from the Mammoth Cave in Kentucky, sulphur from Sicily, and willow charcoal from the willow trees grown at the plant, made a fine grade of powder and had built up a large export trade. Working around the clock, seven days a week, these plants supplied the Union Army from 1860 to 1865 with more than 26 million pounds of powder and also retained their export trade throughout the war. The DuPont plant was the largest one with an annual capacity of one million tons. Incidentally, the average price of gunpowder in the Civil War was 24½ cents per pound and the current price is 33 cents per pound, although the fifteen plants of 1865 have shrunk to one making black gunpowder in 1960.

The chemical industry expanded production 500 percent from 1860 to 1865. It did a fine job but could have done more if the military had given it the job. Gun cotton and nitro starch were well known in Europe and could have been made here. Rockets with military heads and capable of ranges of more than 5000 yards had been used in the European armies for sixty years—and included a 300 pounder, 10 feet in length. Accuracy was secured by rotation produced by multiple orifices at an angle in the base plate.

The Washington, D. C. Arsenal began production of 2½ and 3½ inch rockets in 1847 but this work was soon stopped for lack of interest. The powder plants could have made the propellant, but rockets were limited principally to signal and coast guard rescue use. In 1919 development of a rocket carrying a tear-gas head was dropped for the same lack of interest.

At no time in the Civil War was a military operation hampered by lack of gunpowder. To meet the shortage of imported saltpeter a satisfactory powder was made from Chilean sodium nitrate. To reduce the pressure in large cast iron cannon a slow burning large grain powder was developed which a hundred years later found a use in the ballistic missile program.

After the Civil War the industry continued to grow, particularly in inorganics, at an annual rate of approximately 11% for fifty years. However, the military establishment made little use of new chemical developments. Although gun cotton and smokeless powder were well known and we had developed a good repeating rifle at the end of the Civil War, we entered the Spanish-American War in 1898 with black powder and single shot rifles.

Lack of tariff protection allowed the European chemical industry to prevent almost completely the development of an organic chemical industry in this country prior to 1914 when the chemical industry faced a terrific job as many old timers remember. We had a natural dye industry in 1860 but in 1913 had only one synthetic dye plant, located at Buffalo and now part of Allied Chemical Corp.

During World War I the chemical industry expanded by 300 percent and established a broad organic chemical and dye industry. Faced with chemical warfare, the military-industrial team built in 1917-1918 production of chemical warfare agents to four times that of Germany and equal to the combined British-French capacity. From 1919 to 1939, with long needed tariff protection, seized patents, and research, the industry continued to grow and diversify at an annual rate of 11 percent and moved into world leadership in all lines of chemicals.

In 1939 the industry crossed the billion dollar mark in sales, a big jump from the five million dollars in sales for 1860. We had a firm industrial base for the military requirements of the day and flexibility to produce the unforeseen items developed by changing military technology.

Fortunately, the chemical industry had also developed a group of leaders with memories of 1914 and, with World War II around the corner, they began planning with the industrial mobilization organization then under the Assistant Secretary of War. The names of these chemical leaders and the work they did will not be recorded in school histories, but without their advance planning, we would not so readily have become the "Arsenal of Democracy" in 1940. However, despite this planning, the chemical industry again expanded under a "crash" program by 300 percent from 1940 to 1945. The industry again came through with successful production of items such as synthetic rubber not dreamed of in the original planning.

In 1945 we began to convert our war-time expansion to civilian uses and to further expand at a rate of 7½% annually. Despite this growth, the outbreak of war in Korea in 1950 produced a rapid expansion of 20 percent to meet new military demand. From 1951 to 1957 the expansion rate was about 8 percent—then dropped to half this rate. It is now back to about a 7-8 percent rate but it has been estimated that in the next decade chemical demand will double from the present figure of about 26 billion dollars to around 52 billion so that capacity just to meet civilian and export demand must step up the present expansion rate.

GROWTH CHEMICAL INDUSTRY
1860—1960

Period	Average Expansion Dollar Volume/Year
1850-59	1%
Civil War	50%
1865-1913	11%
WWI	66%
1919-39	11%
WWII	76%
1945-49	7½%
Korea	20%
1952-1960	High 8% Low 4%

A historical review such as this is of value in forecasting the future. Today, our world is faced with clashing ideologies—dictatorship versus democracy—a conflict which could be dated from 1913. A review of Wars of Ideology for the past thousand years indicates that they lasted in many cases more than one hundred years; for example. The Crusades, the religious wars of the Middle Ages, the Mongol invasion of Europe. These wars switched periodically from cold to hot and eventually the clashing forces reached a peaceful solution. While the current military thinking is swinging from the possibility of a general war which could mean

mutual suicide, we have the threat of limited wars which could spread. Even a limited war such as Korea, because of increased firepower and rocketry, would pose a big chemical demand.

Man has been evolving more slowly than technology and despite the aspiration for peace, it is at least conceivable that there could be more war before we reach a permanent peace. In such an eventuality, the chemical industry would be called upon again for a tremendous expansion because the few requirements of 1860 have been multiplied hundreds of times.

The per capita consumption of chemicals in 1860 is estimated as 16 cents; by 1939 it was $100.00; today it is $140.00, and it is estimated this figure will double in the next decade. The Bureau of Census estimates that our population will increase about 18 percent in the next decade, and every individual represents an increasing chemical consumer from birth to the grave. It does not require much calculation to see that with the ascending rate of consumption and population our present rate of expansion would leave little excess capacity for war; this, despite the fact that about 3 billion dollars in tax amortization certificates to aid military chemical production were issued from 1954 to December 31, 1959.

Today, military rockets, in their embryonic state, are burning up more chemicals, annually, than were consumed from 1860 to 1865. Today's rate is a drop in the bucket to a war-time rate. However, a quick look at today's chemical industry versus 1940 reveals several advantages. We have the skeleton of an organization for mobilization. Today we have a widely distributed, integrated chemical industry rather than vulnerable single key plants. Today we have a civilian market for practically every chemical we would need in a major war, but even with drastic curtailment of civil uses we would need expansion. Failure to meet military war demands could only result in quick, complete destruction.

In WWII we needed glass-lined kettles, piping, valves, stainless steel, pumps, motors and chemical knowhow to expand. However, today chemical plants are not so simple. Chemical equipment will not be the bottleneck—it will be electronic control equipment. As compared with 1940, new 1960 plants are empty of manpower who have been replaced by dials, transistor tubes and electronic tapes. These are the same items needed to launch and guide missiles and to control a far flung military force on land, air, sea and space. Electronic control equipment may be the key to war-time chemical expansion.

Mobilization planning of chemicals never was simple because of changing demands, but it is far more complex today. Planning is a job for today—not under the lash of war. It calls for a new group of chemical statesmen with vision and unlimited support of military and industry to repeat the job of 1940.

We have a continuing need to compute chemical requirements assuming that we will in case of a maior war become again the "Arsenal of Democracy". The plants best suited to expand to meet the demands for commercial items should be selected and detailed mobilization plans prepared and kept up to date at government expense. New capacity to meet initial demands should be built now, either as part of existing plants or at a suitable location if necessary. The cost of having immediately available such capacity will be small compared to the cost of not having it available at all. Substantial sums are being spent on government plants to produce rocket propellant but to insure adequate output planning must extend to the raw materials.

Arsenal prototype production has paid big dividends in the past especially in bringing into production small plants. The tendency in recent years to reduce government arsenal operation should be reversed and our arsenals expanded to again become the permanent repository of prototype knowhow. This is a national defense responsibility to insure complete industrial mobilization of both large and small producers over a wide area.

There are many objections to such detailed planning. Many anticipated chemical demands never materialize and the plans are wasted. Wars are always wasteful—they waste resources, manpower, and the net gain has little real value. However, wishful thinking will not hasten the evolution toward peaceful solutions of problems over which man has fought since caveman days. Moreover, the planning that does pay off gives our industry more resources to solve the unforeseen demands which arise in every war. This is a job for an industry-military team of the best brains we can mobilize. The physiological effect of having plans to immediately mobilize our industrial strength may prevent any potential enemy from starting a major war since no one will start it unless he thinks he is stronger.

This review of the past century began with the bloodiest war in history and is ending in a year of troubled peace with many millions of the young men of the world under arms. Will we have another century of the same?

In conclusion, the following extract is quoted from a letter dated August 11, 1856 to the Secretary of War, written after his survey of the armies in Europe, by Major Richard Delafield, Engineers, Superintendents of Defense, Harbor of New York:

"Our resources are unquestionably great, and equal to several of the powers of Europe combined, but our preparation in material, equipment, knowledge of the art of war, and other means of defense, is as limited and inefficient, as theirs is powerful and always ready.

"As a nation, other than in resources and general intelligence of our people, we are without the elements of military knowledge and efficiency for sudden emergency; while no nation on earth can more certainly put itself in a condition to set any hostile force at defiance."

SEES BODY CHEMISTRY OF ATHLETES SUBJECT FOR COLLABORATIVE STUDY

EDGEWOOD, MD.—Intensive study of the behavior of body chemicals during and after strenuous exercise was urged by Dr. David B. Dill, deputy director of medical research at Army Chemical Center here, and an Army authority on fatigue. Addressing the National Conference on Medical Aspects of Sports at Dallas, Texas, on November 30, 1959, he suggested that a joint effort between athletic coaches and physiologists would prove beneficial.

"Coaches have many practical questions that cannot be answered satisfactorily within the laboratory but perhaps can be attacked successfully in joint studies by coaches with a physiological flair and physiologists with athletic backgrounds," said Dr. Dill.

He cited outstanding research on training methods carried out by Sid Robinson, a 1928 Olympic track star who later became an eminent physiologist and now heads the department of physiology and anatomy at the University of Indiana.

A former director of research at the Harvard Fatigue Laboratory, Dr. Dill has participated in a number of tests designed to help explain the effects of exertion on the chemical make-up of the body.

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THE SEARCH FOR THE RED PILL

By DOUGLAS LINDSEY, M.D., DR.P.H.* and
D. B. DILL, PH.D., D.SC.**

SOME PERSONS who presume to know the facts may tell you that anticholinesterase agents (such as the "G" gases) are obsolescent, and they can tell you why. The reason why (they say) is that medics everywhere are supposed to have an effective means of prevention and treatment of casualties from these agents so effective that the tactical value of the agents of this type is destroyed. Furthermore, these commentators can tell you what this preventive or treatment medication will look like: it appears to be a foregone conclusion that it will be dispensed as a pill, and the odds are heavy that the pill will be *red*. One or two pills a day will make the soldier immune to any "G" gas the enemy may throw at him, and the pills will hold good for the non-volatile anticholinesterase agents which circumvent the mask by penetrating the skin.

The situation, as these commentators have it, is alleged to be highly disturbing to Chemical Corps scientists who are searching for new lethal agents, because, if the "G" class of agents are to be considered on the way out, exploration for entirely new classes of compounds becomes essential.

From a different standpoint the same situation is also disturbing to us in medical research. The "red pill" is an illusion. At least it is so far.

It is our job in the Corps to be in continuous intellectual contact with Chemical Corps scientists who are working on these problems, and to keep closely abreast of comparable research in the scientific world at large. A great wealth of data is available in this field. From all of these data, and from many ideas and clues—gratuitous or sought-after—we are forced to conclude: the red pill is not on the shelf; the red pill is not in a development stage; the red pill is not yet on the research horizon. We are not at all sure that it even exists *beyond* the horizon. Furthermore, we are convinced that it is not worthwhile to make an all-out effort to find it. There is too much else to do.

Perhaps we give too pessimistic an impression. A great deal is known about the pharmacology of anticholinesterase agent poisoning. One *can* treat successfully against massive poisoning with such agents. There is promise of a modicum of medicinal prophylaxis, at least under laboratory conditions. All these are hopeful signs, and tangible scientific achievements. But they do not add up to the vaunted "red pill." Certainly they do not approach the stage of seriously detracting from the tactical punch of a very powerful class of chemical agents.

Let's look at the facts, their implications, and some inferences.

The facts are from experimental data on animals, and experience with men accidentally exposed. The implications should be clear. We will shoulder full responsibility for the inferences.

With atropine alone, in unlimited dosage, it is possible to save men who have received 3 lethal doses of a typical anticholinesterase agent. Much beyond that, no. With artificial respiration alone—no atropine—the figure is about the same or a little higher.

With both atropine and artificial respiration animals have been saved from as much as 100 lethal doses.

When certain oximes are added to the treatment regimen, the figures rise again. The oximes are disappointingly impotent when used alone in severe poisoning. But in appropriate dosage an oxime plus atropine will permit survival of animals after, say, 50 lethal doses; and with an oxime plus atropine plus artificial respiration the figure may rise to several hundred lethal doses.

There are several conclusions which can be drawn from these data:

1. Atropine is no substitute for artificial respiration, but it helps.

2. The oximes are not substitutes for atropine, but they help too.

With the three together, we can hold out the possibility of protection against several hundred lethal doses. Pretty good, eh? Or is it? Is it of any practical battlefield value to be able to save a man who has been exposed to 100 lethal doses of anticholinesterase agent? How often will such massive dosage occur? Rarely by accident. Almost never by design—figure up the munitions expenditure necessary to lay such a concentration over any significant area of a battlefield! What is needed in the way of better treatment is not ability to protect against more and more lethal doses, but treatment which is simpler, and more certain, in protection against practical doses under practical conditions. We are trying to better our treatment by these standards. Meantime, where do we stand now according to the criteria of practicality?

Imagine a battle group of the modern United States Army. It is ready for combat on one of our far-flung international perimeters. It is dug-in for protection against nuclear weapons. It is fully dispersed—at least as fully as present Fort Benning doctrine calls for in position defense.

Even so—dug-in and dispersed—it is no problem for a potential enemy to hit it so hard with an anticholinesterase agent that it sustains 30% casualties in a matter of seconds. For this unit, 30% casualties is something over 400 men. To oversimplify, we might consider these 400 men in four groups of 100 each.

One-hundred men will have received less than a lethal dose of the agent, but quite enough of it to put them out of action temporarily. They will survive; that is, they will survive if the unit is not overrun by the enemy. They will survive whether they take effective medical treatment measures or not. If they use their atropine syrettes promptly, they will return to military effectiveness in a relatively short time.

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**Deputy Director of Medical Research, U.S. Army Chemical Warfare Laboratories, Army Chemical Center, Maryland; Contributing Editor, Armed Forces Chemical Journal.

One-hundred men will have received more than one lethal dose, but not a great deal more. They will survive if they use their atropine syrettes soon enough, though they may be incapacitated for some time.

One-hundred men will have received several lethal doses, so that a single dose of atropine will not suffice to insure recovery. These men will survive if they receive artificial respiration, or they can be protected from death by massive doses of atropine, provided it is given in time. The time limit may be something on the order of 3-5 minutes. These men may be in such an advanced state of circulatory collapse that no veins can be found for injections, and certainly intramuscular injection is futile at this stage. The only recourse open to the aid man is to inject the atropine into the heart, or to inject it via a long needle directly into the substance of the lung. By "massive" atropine we mean truly *massive*. A single syrette of atropine (2 milligrams) is massive by normal clinical standards; a common dose of atropine in hospital practice is 0.4 milligrams. But here we refer to many milligrams. The dose required may run to something on the order of 300 milligrams—the equivalent of 150 syrettes! Obviously the aidman cannot prepare and use this many *syrettes* in time, at least not by intracardiac injection. He must have available for emergency use a supply of atropine in "bulk" solution form.

One-hundred men will have received such a high dose of the agent that atropine will not insure recovery, not even in massive doses. These men must have artificial respiration in order to survive. They must have effective artificial respiration, begun immediately, and continued without interruption for 4-6 hours or more. By effective respiration we mean something quite particular. The various external pressure methods of respiration (Shafer prone pressure; Holger-Neilson back-pressure arm-lift) will simply not work in severe anticholinesterase poisoning. The only effective emergency means known to us to date is mouth-to-mouth resuscitation, which involves inflation of the victim's lungs with the expired air of the rescuer.

Now note in recapitulation: of these 400 casualties, every single one can be saved by technical means which are currently available. But will these technical means be available under tactical conditions? Under the dispersed conditions of modern warfare, can the company aid man make the rounds of his casualties and administer massive doses of atropine in 3-5 minutes after the strike? If he could, is he presently trained to judge the dosage of atropine by clinical response, and to give atropine by intracardiac or intrapulmonary injection? If the aidman cannot, then who *will* give the injections?

With the reasonable presumption in mind that the enemy will follow this chemical attack with a ground assault, what commander can afford to tie up a hundred or more *able-bodied* men in order to give artificial respiration to the casualties who must have it in order to survive? If he does not, these men will surely die; if he does, then perhaps the entire battle group will be annihilated. Mouth-to-mouth resuscitation is clearly impractical if the atmosphere is still contaminated. Mask-to-mask resuscitation is possible with some simple gadgetry (and some intensive training). The gadgetry is in the final development stages, but will the Army see fit to issue one or two sets to every rifle squad? If not, will they be available when needed?

The answers to these individual questions are immaterial. There can surely be no pat answer to *all* of them, and the net effect (to us, at least) is to indicate that technical competence in the treatment of poisoning from anticholinesterase agents does not detract from the tactical potential of these agents.

There is no implication in this that the art of medical treatment of such chemical casualties is in a shabby state. Rather, it is in an excellent state. Compare, for example, the state of the art of immediate treatment of casualties from bullets and shell fragments. Oversimplifying again, but not unfairly, we may state that a 1 millimeter hole through the heart is less than a lethal dose, and a 2 millimeter hole is a lethal dose. What then, of a 7.62 millimeter hole through the heart? At any rate, it is virtually sudden death even if the casualty is shot on the front steps at Walter Reed, and a 2-4 millimeter hole is clearly unsalvageable under battlefield conditions. We speak high praises of the high state of present-day military surgery, and rightly so. In comparison, the treatment of casualties from anticholinesterase agents is far ahead. But we still do not have the red pill.

Perhaps you are willing to grant us this conservatism or pessimism—that the red pill is not yet in sight—but are unable to forgive our reluctance to go all out in looking for it.

This reluctance is not lack of initiative or interest. It is just that there are too many other things which need doing. We badly need an effective treatment for the lesions caused by vesicants such as mustard. We are old-fashioned enough to feel that mustard is still the King of Chemical Warfare, and our medical prophylaxis and treatment capability here is almost nil. We are still groping in a vast darkness for some rational approach to the treatment of pulmonary edema, such as that caused by phosgene and other more powerful irritants of the respiratory tract. We face an entirely new problem in developing pharmacological counters to the various potential psychochemical agents.

We will continue our basic research on anticholinesterase agents. We will track down any good leads we run across. Perhaps we will stumble on the red pill, or something approaching it. But until we do, these remain very powerful weapons of war, available both to the United States and to all of its potential enemies.

CWS HISTORY ON SALE BY A.F.C.A.

Arrangements have been made with the Government Printing Office whereby the volume of the Army official histories, "U. S. Army in World War II, The Technical Services, The Chemical Warfare Service: Organizing For War," by Dr. Leo P. Brophy and Col. George J. B. Fisher, may be procured through the Armed Forces Chemical Association. The price of this volume is $4.00.

Orders placed with the Association will be handled without delay. They should be directed to:

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A NEW SCREENING SMOKE FORMULATION INCORPORATING SULFAMIC ACID

By SIDNEY J. MAGRAM* and JAMES D. WILCOX

U. S. Army Chemical Warfare Laboratories
Army Chemical Center, Maryland

DURING WORLD WAR II, experiments were conducted on a wide variety of formulations for colored smokes (1). At that time it was noted that the incorporation of ammonium sulfamate, supposedly a cooling agent, into mixtures of potassium chlorate, sulfur, and dyes resulted in mixtures that were smoother burning and less likely to flame than the then standardized formulations (2). However, ammonium sulfamate being hygroscopic, made the mixing of dry powders difficult at high humidities.

The improved burning performance of smoke formulations containing ammonium sulfamate was not understood. Various possible reasons for this result were considered. Although an explanation has not been obtained, it is believed that the ammonium sulfamate was acting in some manner in addition to that of a cooling agent, which absorbs heat through thermal decomposition. Since it has a sulfur-to-nitrogen bond it could be oxidized readily at high temperatures with the evolution of heat. Molten ammonium sulfamate is also probably a good solvent for potassium chlorate.

The improved burning performance obtained with the addition of ammonium sulfamate to smoke mixtures led to investigations with sulfamic acid which is a stable, readily available solid essentially non-hygroscopic up to high humidities. It was thought that the oxidation of sulfamic acid to produce volatile hygroscopic gases should result in a good screening smoke (3). Sulfamic acid might also be an interesting fuel additive for some smoke mixtures. It could not be used, however, with colored smoke formulations containing potassium chlorate, since such mixtures would be strongly acid even in the presence of small amounts of moisture. The free chloric acid, which would be liberated, is such a strong oxidizing agent that it would react at room temperature with combustible materials. However, sulfamic acid should be stable in the presence of oxidizing salts whose acids are also strong, such as the perchlorates and nitrates of alkali metals. Therefore, it was decided to confine this study to mixtures of sulfamic acid with these oxidizing agents.

In the expected reaction of ammonium perchlorate and sulfamic acid,

$$5NH_2SO_3H + 3NH_4ClO_4 \rightarrow 5SO_3 + 4N_2 + 12H_2O + 3HCl$$

all the products formed are volatile; there should be no residue. It was calculated that a stoichiometric mixture required 42% ammonium perchlorate and 58% sulfamic acid.

In laboratory tests, mixtures of sulfamic acid and the four oxidizing agents were prepared by mixing the ingredients with a spatula by hand, and pressing into either 100-ml. beakers of 30-ml. cans. The mixtures were then ignited with the aid of a coil of electrically heated wire, which eliminated the need for a starter mixture in these laboratory tests. The reaction rate was evaluated by the burning rate, the quality of the smoke produced, and amount of residue observed. Potassium perchlorate, ammonium nitrate, and sodium perchlorate as oxidizing agents with sulfamic acid proved unsatisfactory in producing a good screening smoke.

The best results were obtained with a mixture of 42% ammonium perchlorate and 58% sulfamic acid, the stoichiometric quantities, which produced a smoke that had a very pure white appearance and exceptionally good light-scattering qualities.

A large-burning-surface M18-type (4) grenade was filled with the sulfamic acid-ammonium perchlorate mixture (58%-42% by weight) and pressed in an M18 grenade container. Using British starter mixture (5) the experimental grenade was burned in the field simultaneously with a standard M8 HC grenade (6). Burning times and the smoke clouds produced were compared.

The smoke from the HC grenade (5,7) had a marked grayish cast. The density of the smoke from the experimental M-18 grenade appeared to be as good as, or better than, that from the HC grenade and was very white. The burning times were 1 min. 28 sec. for the M18 type, as compared with 1 min. 15 sec. for the MS HC grenade.

In these trials, the smoke produced by the sulfamic acid mixture appeared to have the advantage of not rising above the ground as much as the smoke from the HC grenade. However, it would be expected that a cooler burning smoke would show less thermal rise. As observed visually, the quality of the smoke obtained from the experimental mixture was as good as, or better than, that obtained with the HC grenade.

In a preliminary evaluation of the stability of the new smoke mix, a sample was stored at 165°F. for 72 hr. and then tested for ease of ignition, burning time, and amount of residue. The results of these tests indicated that no change or decomposition had occurred during storage. Therefore, surveillance tests of experimental grenades were initiated.

M-18 type grenades were filled with sulfamic acid-ammonium perchlorate mixture (58%-42% by weight) by the Munitions Development Division, U.S. Army Chemical Warfare Laboratories, and then placed in tropic, desert, and ambient storage by Test Division, U.S. Army Chemical Warfare Laboratories, for a 12-wk. period. At various intervals, grenades were removed from storage and burning times were determined. Burning time was used as an indication of the stability of the M18-type grenade filled with the sulfamic acid-ammonium perchlorate mixture during storage. These tests indicated that no appreciable decomposition or instability was encountered.

Sensitivity tests were performed by the Bureau of Mines, Division of Explosives Technology, Pittsburgh, Pa., on the sulfamic acid-ammonium perchlorate smoke mixture (58%-42% by weight). The results of these sensitivity tests showed that the sulfamic acid-am-

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monium perchlorate mixture is not sensitive to friction, static spark, or impact. The ignition temperature is well above safety limits.

The study with sulfamic acid and a limited number of oxidizing agents resulted in the formulation of a new candidate smoke mix. A mixture of sulfamic acid and ammonium perchlorate (58%-42% by weight) produced a white screening smoke with a greater screening value than HC smoke. The new smoke produced less thermal rise than HC smokes. It also eliminates the need for fine metallic particles required in other smoke mixtures. This new smoke mixture appears to be stable under tropic, desert, and ambient surveillance test conditions. The mixture appears to be safe to handle. The smoke is essentially a pyrotechnic generation of an FS type.

This new smoke, which is acidic in nature, has irritancy characteristics which are comparable to those of FS (chlorosulfonic acid) (8). No attempt was made in this study to investigate all possible methods and mechanisms of neutralizing or eliminating the irritancy of this smoke. A non-irritant variety of this smoke would increase the possibility of using this screening smoke in a greater number and wider variety of tactical situations.

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NAVAL RADIOLOGICAL DEFENSE LABORATORY APPOINTMENTS

The 12th Naval District Public Information Office for the U. S. Naval Radiological Defense Laboratory, San Francisco, California, has announced the appointment of three radiological chemists as follows:

Dr. John Y. Yang, as a new member of the Radiation Chemistry Branch, formerly at Brookhaven National Laboratory; Mr. Vernon Akamian, a new member of the Nuclear and Physical Chemistry Branch, a graduate of San Jose State College; and, Mr. Warren J. Heiman, re-joining the staff after several years absence for study and work in industry.

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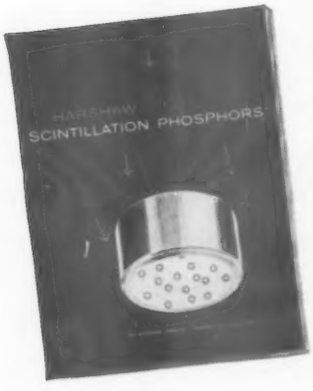

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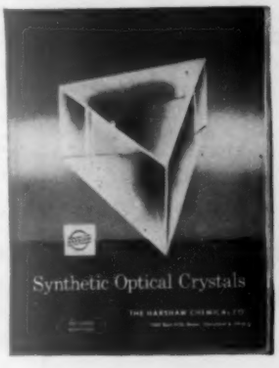

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ARMED FORCES DAY-MAY 21

Again this year, as for a number of years past, the slogan of the Armed Forces for Armed Forces Day—May 21—is "Power for Peace."

While the celebration is listed in accordance with the President's Proclamation for the third Saturday in May (May 21), the program of military exhibits, demonstrations and exercises at posts, camps and stations will be conducted through the entire week May 14-21. All of the Armed Services—Army, Navy, Air Force, Marine Corps, Coast Guard and Reserve components will participate in the programs.

Execept for certain obvious security restrictions, posts, camps and stations will be open to the public during the celebration period.

Arrangements for the elaborate exhibits and demonstrations designed to familiarize the people with the progress in military preparedness include the subdivision of the country into seven (7) geographical areas. These areas, and also the overseas districts included in the program, together with the name and address of the general or flag officer in charge of the program in each area, and of the area project officer, are listed herein:

AREA I (Colorado, Illinois, Indiana, Iowa, Kansas, Michigan, Minnesota, Missouri, Nebraska, North Dakota, South Dakota, Wisconsin, Wyoming)

Area Commander: Lieut. General W. H. Arnold, Commanding General, Fifth U. S. Army.

Area Project Officer: Colonel W. L. Slisher, USA, Hq Fifth U. S. Army, Chicago 15, Illinois

AREA II (Arkansas, Louisiana, New Mexico, Oklahoma, Texas)

Area Commander: Rear Admiral Frederick B. Warder, Commandant, Eighth Naval District

Area Project Officer: Captain Raymond B. Jacoby, USN, Hq Eighth Naval District, U. S. Naval Station, New Orleans 40, Louisiana

AREA III (Arizona, California, Idaho, Montana, Nevada, Oregon, Utah, Washington)

Area Commander: Rear Admiral George L. Russell, Commandant, Twelfth Naval District

Area Project Officer: Captain S. P. Weller, USN, Hq Twelfth Naval District, Federal Office Building, San Francisco 2, California

AREA IV (Connecticut, Maine, Massachusetts, New Hampshire, New Jersey, New York, Rhode Island, Vermont)

Area Commander: Lieut General William E. Hall, Commander, Continental Air Command

Area Project Officer: Brig General Royal Hatch, Jr., USAF, Hq Continental Air Command, Mitchel AFB, N. Y.

Area V (Delaware, Kentucky, Maryland, Ohio, Pennsylvania, Virginia, West Virginia)

Area Commander: Lieut General G. W. Read, Jr., Commanding General, Second U. S. Army

Area Project Officer: Colonel Edward B. Crossman, Hq Second U. S. Army, Fort George G. Meade, Maryland

AREA VI (Alabama, Florida, Georgia, Mississippi, North Carolina, South Carolina, Tennessee)

Area Commander: Major General Chester E. McCarty, Commander, Fourteenth Air Force

Area Project Officer: Colonel Charles M. Opell, USAF, Hq Fourteenth Air Force, Robins Air Force Base, Georgia

AREA VII (District of Columbia and neighboring areas of Maryland and Virginia within the Military District of Washington)

Area Commander: Major General Charles K. Gailey, Jr., Commanding General, Military District of Washington

Area Project Officer: Colonel Donald B. Miller, USA., Hq Military District of Washington, Washington 25, D. C.

OVERSEAS COMMANDS

ALASKAN COMMAND: Lieut General Frank A. Armstrong, USAF, Commander in Chief

Area Project Officer: Lieut Colonel Ernest L. Smith, USAF, Hq Alaskan Command

CARIBBEAN COMMAND: Lieut General Ridgely Gaither, USA, Commander in Chief

Area Project Officer: Rear Admiral Lewis S. Parks, USN, Commandant, Fifteenth Naval District, Fort Amador, Canal Zone

EUROPEAN COMMAND: General Lauris Norstad, USAF, Commander in Chief

Area Project Officer: Mr. Edward Pope, DAC, Hq European Command

PACIFIC COMMAND: Admiral H. D. Felt, USN, Commander in Chief Area Project Officer: Captain Thomas H. Taylor, USN, Hq Pacific Command

THE WHITE HOUSE

WASHINGTON

December 3, 1959

ARMED FORCES DAY 1960

Each year during the past decade, the active and reserve components of our Armed Forces have joined with civil authorities and community leaders to give our citizens and the people of other countries an opportunity to become better acquainted with the military aspects of our national strength. This opportunity is offered on Armed Forces Day.

It is America's hope and purpose to work continually toward peaceful adjustment of international differences, and it is fitting that Armed Forces Day again emphasize the fact that our strength is dedicated to keeping the peace.

Here at home the men and women of the Armed Forces are active members of the communities where they are stationed. Overseas they are ambassadors of good will, helping to create that climate of international understanding in which men can together build a world of justice, progress and freedom.

Dwight D. Eisenhower

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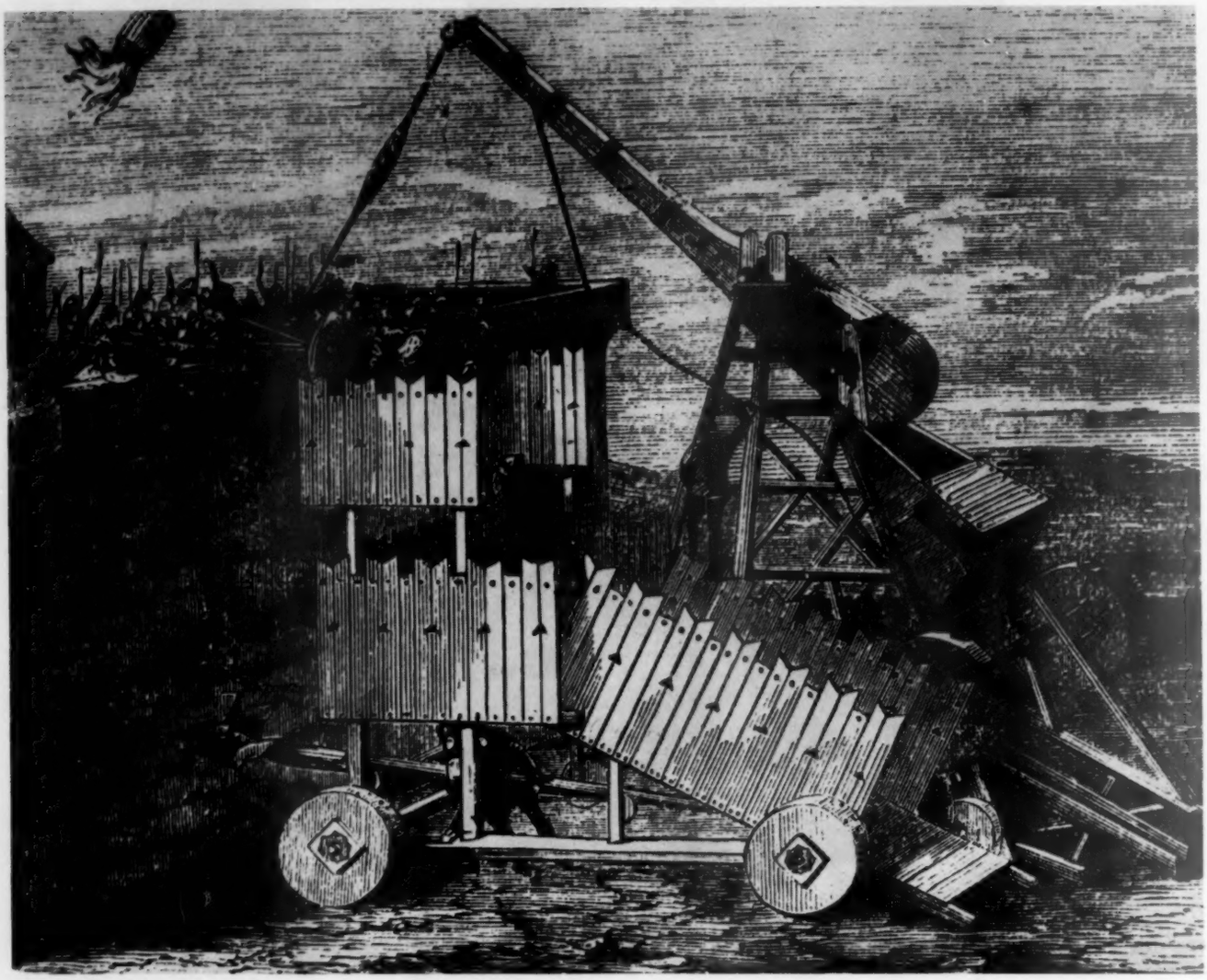
CHEMICAL WARFARE IN HISTORY

(The illustrations herewith of early chemical warfare means and methods are from recent photographs of old prints and manuscripts in the historical files at Army Chemical Center)



FIRE-FLINGING CATAPULT—Invaders use a mammoth armored catapult to throw flaming firekegs over the wall of the besieged city. In the days before gunpowder, the catapult was an important weapon for hundreds of years.

By 1ST LIEUTENANT JAMES K. BATTEN

Public Information Office

Army Chemical Center, Maryland

WHEN THE GERMAN ARMY unleashed its first choking cloud of chlorine toward the Allied lines at Ypres, Belgium, in April, 1915, most of the world thought it was witnessing the beginning of an utterly new era in warfare.

Nothing could have been further from the truth. Chemical warfare, a field which embraces military use of flame, incendiaries and smoke, as well as toxics, has ancient origins which probably antedate recorded history. Early written records are studded with ample evidence of its antiquity.*

Red-hot coals and flaming brands, the first incendiaries, were used by the caveman to defend himself against both human enemies and wild animals.

In 360 B.C., Aeneas, an obscure Greek militarist—and no relation to the historic defender of Troy—authored a handbook on tactics and generalship. In it, he described a mixture of pitch, sulfur and resinous wood, which when ignited served as an ideal weapon in the defense of walled cities.

Soldiers hurled potfulls of the sticky, flaming concoction from the walls onto the heads of the unfortunate, beseiging soldiers below.

Flaming arrows, first mentioned in accounts of the siege of Troy in 1200 B.C., were described again in 327 B.C. by Alexander the Great as he led his troops into the Punjab in India. In a letter to Aristotle, Alexander wrote of "terrific flashes of flame" showered upon his men.

"Greek fire," probably the most famous type of ancient chemical warfare, was invented by a Greek architect, Kallinikos, around 600 A.D. Believed to contain a

*The concept of chemical warfare as a new development of World War I origin has frequently been explained as referring to its inauguration then as the first application of modern chemical science in the production and use of chemical agents.—Ed.

mixture of pitch, resin, quicklime and sulfur, Greek fire was employed in naval engagements and was the first bona fide use of chemical energy in warfare, since the mixture burst into flame when the quicklime hit the water.

Other authorities contend that the liquid material was ignited and propelled through hollow logs by means of a bellows, clinging stubbornly to and burning on whatever it hit.

Military use of poisons, a forerunner of gas warfare, was employed in countless ingenious ways by ancient militarists.

In 200 B.C., a scheming Carthaginian general ordered his men to retreat in a feigned panic, leaving behind great quantities of wine poisoned with mandragora, a root containing a narcotic.

The enemy rushed gleefully into the deserted camp, downed the poisoned wine and soon fell into a deep, drugged sleep. The Carthaginians then returned to the scene and massacred their snoring foes.

Hannibal is said to have won a naval battle against King Eumenes of Pergamon by flinging containers filled with poisonous snakes into the enemy vessels. The resulting panic—so the story goes—enabled Hannibal's fleet to sweep to victory.

Poison arrows were a stock-in-trade with many ancient armies, and are still used in remote areas of the world. A single arrow's dose of aconite, a poison common in India and China, is supposedly powerful enough to kill an elephant.

Natives of New Guinea and Australia dip their arrows into decaying carcasses, just as, according to Aristotle, the ancient Scythians dipped their arrows into a mixture of human blood and decaying serpents.

Toxic gas, used during World War I, probably had its earliest origins in the smoke from fires of green wood used by ancient man to drive men and animals out of caves and nests.

Kautilya and Ramayana, writing in 2000 B.C. about the wars of ancient India, mention fumes which "caused slumber and prolonged yawning."

INCENDIARY LANCE—This mounted warrior of the Middle Ages used fire lances, setting fire to the enemies' grain fields and fortifications. This weapon could conceivably have also been used against the enemy on the field of combat.

Plutarch wrote that Quintus Sertorius used an ash-like sand in the war against the Charakitanes in Spain, which was driven to the enemy by the wind and caused coughing and blindness.

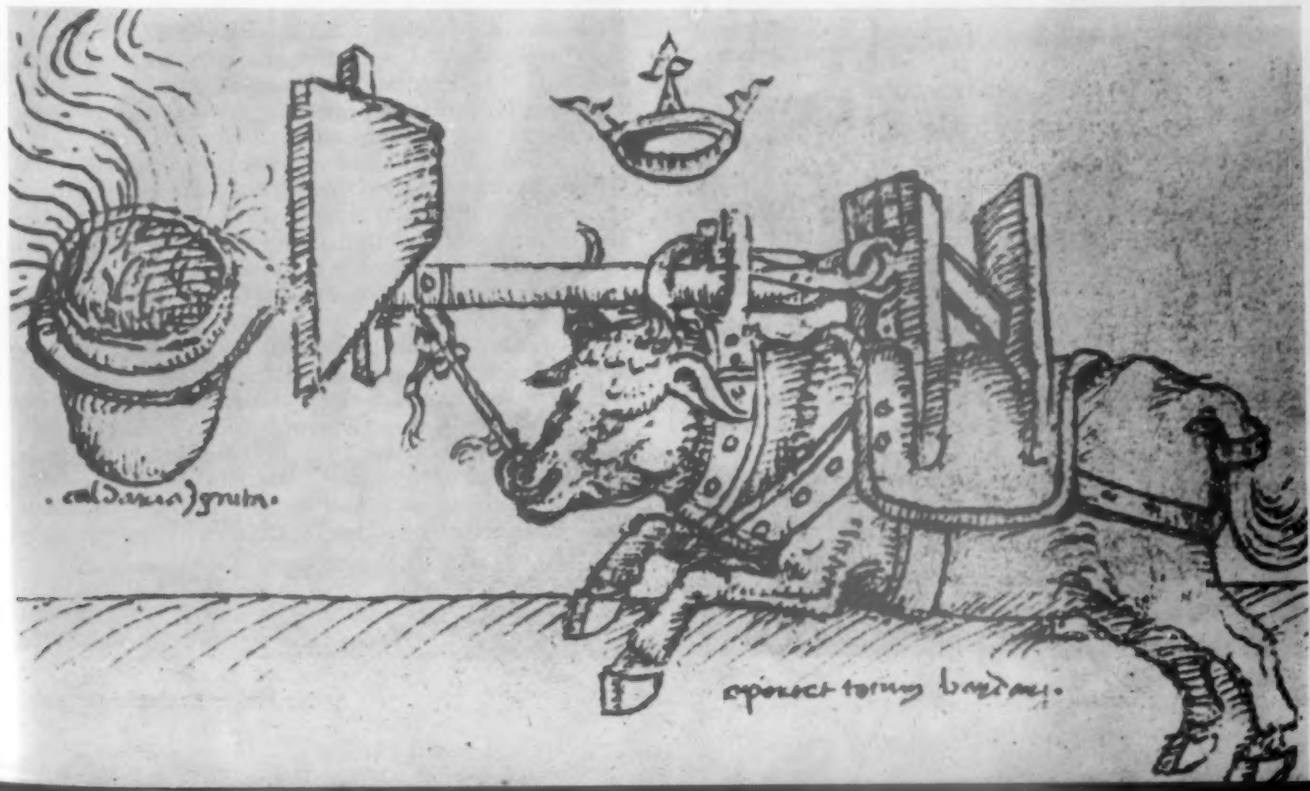
In 1845, the French General Pilissier used smoke from green wood against the Kabyls in Ouled Ria and suffocated the whole tribe in the process. He was recalled by the French government due to the massacre.

During the Crimean War in 1855, Lord Dundonald, a British admiral, suggested the use of sulfur dioxide vapors to drive the Russians from Sevastopol, but the idea was turned down.

Modern gas warfare could have made its debut in the American Civil War if Union officials had listened to

(Continued on page 32)

FIRE-CARRYING BULL, as depicted in a medieval manuscript, was probably set loose in enemy croplands, used to destroy food, timber and perhaps dwellings.



RADIOLOGICAL SAFETY AND THE CHEMICAL CORPS SCHOOL

By 1ST LT. CONRAD M. KNIGHT
Radiological Safety Officer
U. S. Army Chemical Corps School
Fort McClellan, Alabama

RADIOLOGICAL SAFETY is rapidly becoming a major problem in the Armed Services. Items such as electron tubes, nuclear missiles, and radiographic operations, all involving radioactive materials, are becoming more and more common. Each of these items presents an ever increasing problem of protecting personnel from the harmful effects of ionizing radiation. The AEC, having recognized this problem, requires that all installations possessing radioisotopes have personnel qualified in radiological protection techniques.

The protection of personnel against radiation involves not only standards and equipment, but more fundamental, the training of personnel in radiation safety principles and techniques. The Chemical Corps School—an element of the U.S. Army Chemical Corps Training Command at Fort McClellan, Alabama—has organized and is conducting for the Department of the Army a program designed to meet the requirements of this latter activity, that of providing radiological safety training.

The School's training program in radiological safety is currently accomplished by two resident instruction courses. The first, a two week course entitled "Radiological Safety," is primarily concerned with those aspects of radiological safety which relate to safety engineering. The instruction is provided for the safety supervisor who is associated with radioisotopes on a continuing basis. Emphasis is placed on AEC peacetime industrial safety standards, rather than on those conditions resulting from nuclear warfare. The course is organized into three areas; the first treats the fundamentals of radiation, covering the nature of radioactivity, radiation units, and the mechanisms of shielding nuclear radiation; during the second, the student is instructed on the principles of radiation detection, the calibration of RADIAC instruments, and the practical use of laboratory and field instruments; the third area covers radiological safety procedures and includes computations of internal and external dosages, air and water sampling ,and the safe handling and storage of radioactive materials.

Assistant instructors exhibit various techniques for handling radioisotopes. Three important safety principles are depicted: (1) Distance from material (2) Instrumentation, and (3) Shielding of radiation.

ABOUT THE AUTHOR

Lieutenant Knight, a native of Massachusetts, was graduated from Norwich University in 1953, with a BS degree in chemistry. Shortly after graduation, he was called to active duty and was assigned to Fort Devens as Assistant Post Chemical Officer. In 1956 and 1957, he was Radiological Safety Officer for Tank Group 7.2 and participated in tests conducted at the Pacific Proving Grounds during this period. He attended, in 1958, a Health Physics Course at Oak Ridge National Laboratory and is presently assigned to the US Army Chemical Corps School as Radiological Safety Officer, Technical Division.

A second program of instructions covering the health physics area is organized into a one week course titled "USARADCOM Radiological Safety." The content of this course is designed to provide the student with a knowledge of the basic principles, procedures, and concepts of radiological protection directly connected with Nike-Hercules nuclear missile handling. It covers nuclear weapons and radiation, hazards and accidents, RADIAC instrumentation, decontamination procedures, standards for radiation protection, damage control plans, and preparation of radiological safety directives.

In addition to these two courses, all career Chemical Officer Courses contain instruction in health physics and related subjects. It is anticipated that all the career officer classes in the future will include sufficient instructional hours to qualify the graduates as radiological safety officers for Atomic Energy Commission licensing purposes.

The facility of the School having responsibility for radiological safety training and for the control of radiological materials used in the training program is the Health Physics group. Operating under the School's Isotope Committee, the AEC licensed group provides instruction covering dosage determinations, allowable concentrations of radioisotopes, and disposal of radioactive materials and other related radiological safety subjects.

Since the instruction involves working with radioactive material the Health Physics group also provides trained monitors, with appropriate instrumentation, to

Radiological safety student, in one of the well-equipped labs of the US Army Chemical Corps School, operating a Scaler, a device which allows the student to gain experience in identification of radioisotopes through energy determination.

An instructor demonstrates the operation of an instrument used for the detection of small amounts of radioactive contamination on the hands or feet.

An instrument used in the detection and identification of alpha, beta, or gamma emitting isotopes is illustrated.

insure that safe conditions are maintained during the instructional periods. The group also maintains personnel dosage devices, and exposure records for all faculty members and students associated with radioactive material. Various tests and surveys are also performed as required by Department of the Army and Atomic Energy Commission regulations.

At the present time, radiological safety training is open to commissioned and warrant officers, and Department of Defense civilians whose duties involve radioactive materials handling and storage. Four USARADCOM radiological safety and five radiological safety courses are scheduled for FY 60. Additional courses will be programmed for FY 61 to fulfill the Armed Forces requirements for this training.

The increased use by the Armed Services of radioactive material together with the proposed expansion of nuclear reactor power, will result in a greater demand for military personnel trained in radiation protection techniques. The US Army Chemical Corps School through its radiological safety instruction program is constantly reviewing its plans and operating program to meet the demands of the future.

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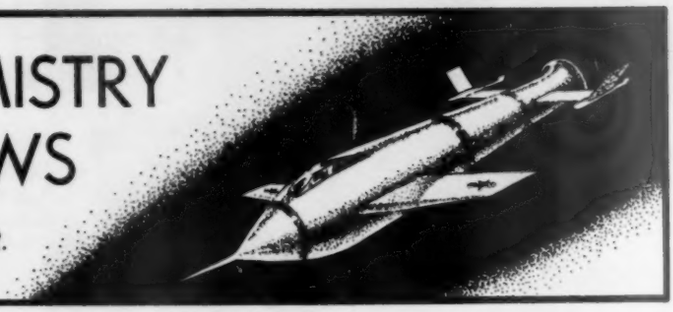

This Department consists of condensations of news releases and of articles in technical journals relating to developments in chemistry, chemical engineering, and kindred subjects, which are of definite or probable military interest. For the benefit of readers who may wish to refer to the source material upon which the paraphrased items are based, the source publications used for this review with appropriate reference numbers are listed after the last item of the text herein.

METALS

A new alloy of which nickel and chromium are the principal components in the ratio of 2:1 handles hot sulfuric acid at 98% concentration. It also bridges the gap between 60% and 80% acid up to 80°C, and is effective with other nonhalogen acids. This alloy is based on the original Illium developed by the late Professor Parr of the University of Illinois. In addition to the two major metals, it contains molybdenum and chromium and smaller amounts of iron, manganese, silicon, and carbon. Special heat treatment of the alloy interrupts the continuity of a secondary phase of the material which is susceptible to the attack of hot concentrated sulfuric acid, thus reducing intergranular corrosion. (1)

After two years of testing, a large chemical plant using a great variety of equipment made partly or wholly of titanium has determined that such use has been justified on a purely economic basis. The places in which titanium is used range from atomizer wheels in dryers, heating and cooling coils, interior liners of pipes, and tracer tubing to a variety of valves. In practically all cases there were no visible evidences of corrosion, only one case of a small pit, and some parts failing purely by erosion. In adition to examination of the apparatus itself, test strips were placed in key process points, titanium being compared in the same environment with some 40 different metals and alloys. Altogether 2300 specimens of these materials other than titanium were tested in 150 different chemical and natural environments. The results have pointed to greater use of titanium on the basis of economy. (2)

Titanium-clad steel equipment has long been blocked in production by the brittleness of welds of the two materials. This difficulty has been overcome by use of a silver inlay between the carbon steel backing plate and titanium. Seams in a steel vessel are closed by putting down a silver inlay at the joint and capping it with a titanium strip. Mild steel has been previously welded to the carbon-steel backing plate. The "spring-back" tendency of titanium is avoided by working it at 500°F to 600°F. Cladding does not become economical until a thickness of 5/16 in. is reached. (3)

Alloys of refractory metals such as titanium, molybdenum, chromium, and vanadium are being made in a single step by producing them directly from their oxides. Operations are carried on at lower temperatures and continuously in an inert atmosphere, the equipment at the same time being markedly cheaper. The general principles of the process are to add to the alloying materials in the form of oxides a stoichiometric amount of a reducing metal so that there is an exchange of oxides. The slag of reducing-slag oxide is taken up by a molten salt as a solvent. The operation is carried on in a crucible heated in an induction electric furnace to 2000° to 2500°F. The molten salt is not only a slag solvent but absorbs heat in order to insure against explosive reactions. The reducing metal also is a source of base metal for the alloy. An aluminum-titanium alloy is typical in which the proportions of aluminum to titanium are 93.8% and 4.6% respectively. In addition to the production of binary alloys, more complex types are being made. As high as 25% titanium is present in some alloys. (4)

The high cost of platinum has greatly restricted its use in industrial equipment and limited it largely to small laboratory ware. A new technique has been developed by which a platinum-steel bond is produced which is similar to that which gives strength to solid metal. The solid-phase bonding process used in uniting platinum and steel uses no brazing alloy or other intermediate materials. The cladding alloy contains 0.5% rhodium. The platinum layer on 0.035 inch ware is only 0.002 inch. Platinum-clad vessels can be used up to 1000°F, and all acids that can be handled in platinum are also safe in this new type of ware. Sheet, wire, and tubing are also available with various ranges of platinum thickness. (5)

Lithium has been barred as a coolant for nuclear reactors as well as other heat-transfer systems because it is reported as causing corrosion at elevated temperatures. This has been attributed to the fact that supposedly "high-purity" lithium may contain from several hundred to several thousand parts per million of nitrogen and oxygen. Since lithium oxide and lithium nitride are not sufficiently different to permit purification by a one-step process, the first removal of the undesirable elements is accomplished by filtration of the metal containing oxygen and nitrogen at 250°C. Oxygen is reduced to 100 ppm, but as much as 400 ppm of nitrogen remain. Titanium sponge at 800°C brings nitrogen to 50 ppm, but has no effect on oxides. Yttrium, on the other hand, brings oxygen to the 100-ppm range, but with 100 hours exposure. Cold trapping reduces oxygen to less than 100 ppm, but does not remove additional nitrogen. A combination of the three methods results in true "high-purity" lithium, so that the way is clear for the use of lithium for purposes from which it has hitherto been barred. (6)

A recent process devised in South Africa and owned by an American company offers possibilities of recovering trace metals from sea water. Surface active agents, both anionic and cationic, are to be employed in this process. Metal ions are collected by sodium salts of fatty or sulfated fatty acids, while anions, including complex

(Continued on page 22)

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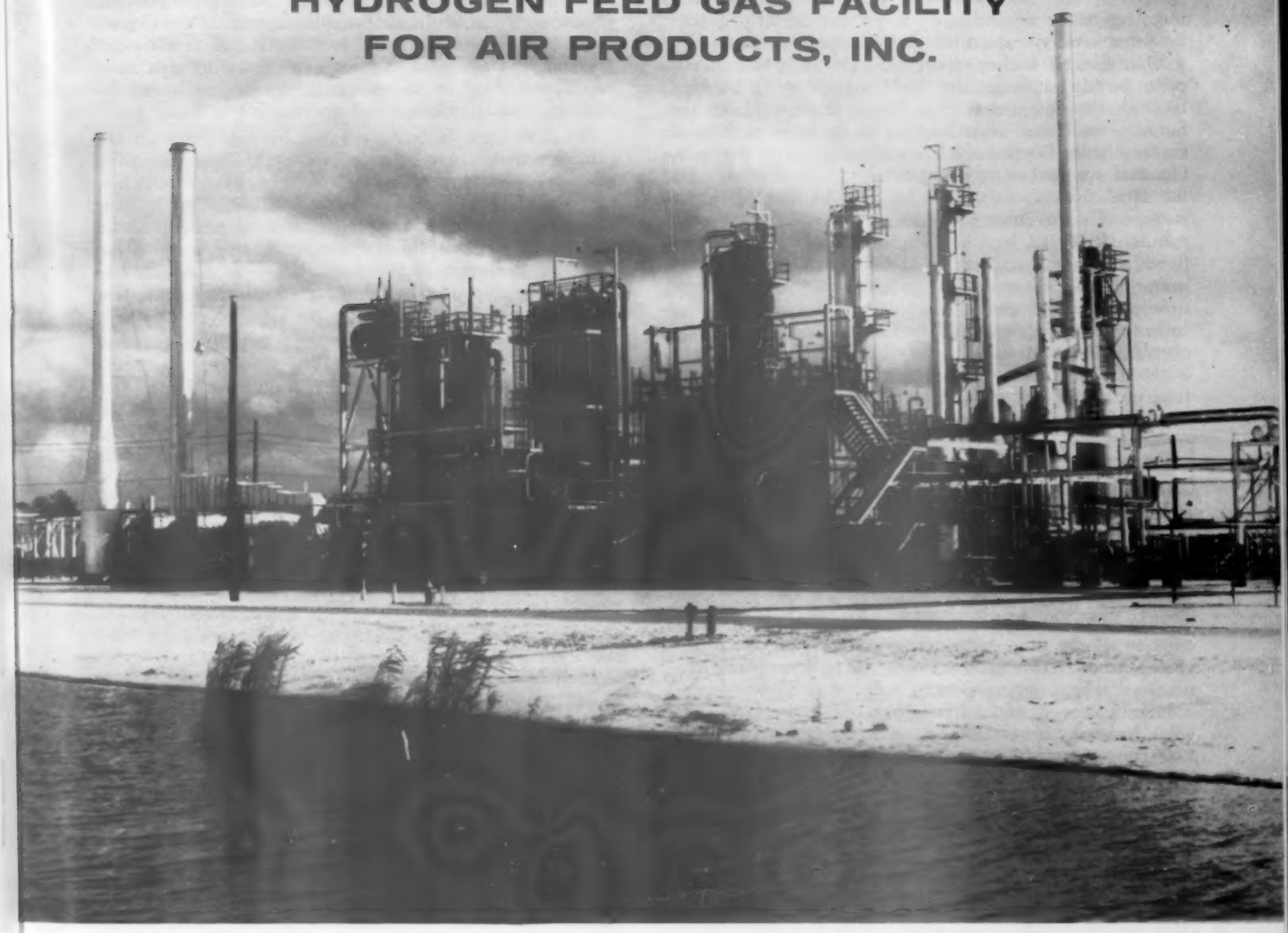

World's Only Large Tonnage Plant Produces Liquid Hydrogen for Use as Missile Fuel

The world's only large tonnage liquid hydrogen facility—near West Palm Beach, Florida—has been put on-stream by Air Products, Inc. of Allentown, Pennsylvania. The Lummus-designed, engineered and constructed hydrogen production section of the plant has been producing at over-design rate and at 99+% purity (better than design) since the test run was successfully completed 21 days after the initial operation of the gas generators.

The hydrogen production section combines Florida crude oil, oxygen and water to generate hydrogen gas.

Liquid hydrogen product from the new facility assumes an increasingly vital role in the nation's defense system. New capability in handling, storing and firing liquid hydrogen in rocket engines substantially improves our nation's position in the race for missile and space superiority.

Lummus has completed a number of gas generation units in recent years, and also has extensive experience in design, engineering and construction of plants for ammonia synthesis.

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(Continued from page 20)

metal anions, are handled by a cationic surfactant such as a quaternary ammonium salt, one radical of which is a 10-carbon or higher chain. Collectors are not in micelle form, but must be molecular. Air is bubbled through the sea water, care being taken to keep the bubbles small and slow-moving to avoid disruption of surface froth. Surfactants are concentrated at the bubble surfaces and attract oppositely charged ions, with the formation of a scum or froth to be carried to the surface. The inventor proposes a pipe 100 meters long, submerged to an equal depth to insure slow current flow. In one hour as much as 27,000 kilograms of aluminum, 50-100 kilograms of copper, 150 kilograms of uranium, and 300 grams of gold may be collected. The collector may be destroyed as froth is ignited and calcined, or the soap may be dissolved in alcohol and recovered. The process may also be applied to purification of chemicals and recovery of by-products from wastes. (7)

ELECTROCHEMISTRY

Three major developments in the field of thermoelectric generators have been recently announced. Contracts are being awarded by the Navy for construction of two portable 500-watt genrators, which are to care for radar and field communications. These generators are to use kerosene as a fuel, and are to operate at a fuel efficiency of 10% in producing a potential of 28 volts, d.c. In contrast to silicon solar batteries, which produce only low voltage d.c., a ferroelectric converter has been announced which will produce both d.c. and a.c. high-voltage power directly from heat. An output of 1000 volts from a "dime-size" converter is announced, and 1,000,000 volts are "theoretically possible". A magneto-hydrodynamic device is being developed which is powered by a plasma of argon gas. A 11-kw unit has been demonstrated. Structural materials are being sought to withstand plasma temperatures over 4000°F. (8)

The first plant for mass production of solar energy has recently been opened. The largest converter of this type ever to be produced was demonstrated as a high light of the plant's opening. It consists of 7800 silicon semiconductor cells, which are distributed over a panel 4 ft. by 8 ft., and which turns on a swivel to follow the sun. All electrical energy over and above that directly used is stored in secondary cells to be used when the sun is obscured. The plant is located in a region that has a high percentage of sunny days. Space-probes will probably depend to a great extent on such converters as an auxiliary power source. Furnaces for crystal growth in the plant are completely automatic, and electrical output per unit of light received is checked by computers. (9)

A recent review of the sources of electrical power covers primary and secondary cells of the usual type, some recent additions, and the fuel cells just coming into limited use on an experimental basis. The lead and acid and the nickel-iron storage batteries, and the dry cell developed over 70 years ago still lead the field. The latter, however, has been greatly improved. A primary battery characterized by large currents and constant voltage depends on zinc and copper electrodes, copper oxide as a depolarizer, and strong caustic soda solution as the electrolyte.

Recent additions include the zinc-mercury dry cell and a solid electrolyte dry cell; the nickel-cadmium storage batteries, both open and sealed; and primary reserve batteries that are activated by addition of a component or by melting a solid electrolyte. Dry cells substituting magnesium for zinc are close to commercial production, and aluminum anodes are being developed. Organic cathodes represent a new field that offers interesting possibilities. Military batteries with high rates and functioning as reserve batteries are activated by such gases and chlorine and ammonia.

Great interest is being created by fuel cells, an old principle that is now said to be very close to becoming practical. The type which is now being given much attention is the hydrogen-oxygen fuel cell. The leading type involves porous, sintered nickel electrodes and an alkaline electrolyte, and operation between 200° and 240°C at pressures of 800 p.s.i. Molten salt electrolytes may be employed at higher temperatures with the use of cheap hydrocarbon fuel.

INDUSTRIAL CHEMICALS

Hydrogen is rapidly becoming an industrial chemical of great importance. The major source of this element is hydrocarbons ranging all the way from the methane, CH_4, of natural gas, diesel fuel, heavy fuel oil, crude oil, and solids such as coal and coke. The water gas process for making a mixture of carbon monoxide is being replaced to a considerable extent by controlled combustion with oxygen. Synthesis gas produces many types of chemicals as well as fuels of desired composition. Hydrogen alone also has many uses, particularly in the nitrogen fixation, organic chemical, plastics, petrochemicals and petroleum products industries. (11)

The most recent development in hydrogen uses is that of liquid hydrogen as a fuel for space vehicles, the common oxidant being liquid oxygen together with liquid fluorine. The Saturn space vehicle, now under development, is expected to carry around one million pounds of liquid hydrogen in four of its five stages, along with the necessary hydrogen. The first stage uses kerosene as a fuel. One plant now in operation has a yearly capacity of one half million pounds, but another is being built to produce 3.3 million lb./yr., which may be expanded to 10 million tons. (12) The plant now in production uses crude oil, which is partially oxidized to hydrogen and carbon monoxide. The latter is oxidized to carbon dioxide, which is removed by amine solutions. Purification of the hydrogen requires several steps in an elaborate system. Liquefaction of the hydrogen depends on ultra-high-speed expanders instead of simple Joule-Thomson effect. Oxygen is obtained from the liquefaction and distillation of air, the nitrogen being a refrigerant. Hydrogen must be converted to the para form before liquefaction, this being accomplished in the presence of a chromium catalyst. (13)

Beryllium is being detected in the field by an exploratory device that can be carried by two men, the instrument being suspended on an 8 foot pole so that neither man is exposed to the gamma rays emitted by antimony-124. About three fourths of this isotope's radiation is above 1.6 m.e.v. Beryllium emits photo neutrons under the gamma ray bombardment, and these neutrons are detected by a scintillation counter. Pulses due to gamma rays are eliminated, leaving only the larger pulses from the photo neutrons. The earphones worn by the operators are replaced when a signal is received, a portable counting register recording the photo neutron count. (14)

A possible rival of sea water as a source of magnesium and bromine is being studied in oil formation waters in Canada, specifically in Wizard Lake and Red-

water fields in Alberta. These waters have high mineral content, and the waters from which valuable chemicals have been recovered are pumped back into the formations. The magnesium content of these waters is a dozen times that of sea water, and the bromine is present in twenty times the sea water figures. From 700,000 bbls. of water per month, magnesium yields would be of the order of 231 tons and bromine amounts to over 48,000 pounds. (15)

Crystal purification and growth methods have recently been improved by two new techniques. Boron is hard to purify by the floating zone method, since the forms made by pressing boron break up easily on removal from the dies. When boron powder is placed on a boiling boric acid solution and the whole is evaporated to dryness, the boron granules are coated with boric acid. This material can be formed by pressure into bars that can be handled. Heating under vacuum converts the boric acid to boron oxide, which melts and solidifies into a strong bond. Indium antimonide is now being produced with no more than one part per billion of foreign material, this being accomplished by preliminary zone refining in a horizontal quartz tube, after which it is poured into a furnace crucile, and pulled as a crystal in a vertical glass column. (16)

The use of high-energy fuels involves danger of boron intoxication. Air Force researchers have developed a method of detecting boron hydride in human and animal serum by a clinical test, which requires only routine laboratory equipment. Reproducibility is of the order of $\pm 5\%$, and freedom from dietary boron characterizes the new test in the fields of biochemistry and pharmacology involving occupational hazards of Air Force personnel. (17)

The Air Force has recently released for industry two reports which deal with the extinguishing of flames, one on present knowledge of the mechanism of flame extinguishment, and the other on flame researches on the effects of halogen-containing compounds. The second report shows that the nature of the oxidizer is the most important in determining sensitivity to chemical inhibition. Combustion with oxygen in most cases can be chemically inhibited, even if compounds and mixtures contain large quantities of hydrogen. Organic nitro and nitrate compounds, however, interfere with the inhibition mechanisms. The effectiveness of bromine and iodine compounds as flame inhibiting agents is thought to be due to a cyclic mechanism which continually regenerates the inhibitor species, which are halogen acids, and to the rapid interaction between the inhibitor species and the chain carriers which give rise to chain branching reactions. (18)

NUCLEAR CHEMISTRY

The behavior of neutrons in nuclear reactors is being studied at Britain's Atomic Energy Research Establishment at Harwell. Prediction of the behavior of nuclear stations in the future may be made on the bais of the behavior of neutrons as they meet materials of construction. Rates of reaction in a reactor, the interaction of neutrons with atoms in the reactor core, loss of neutrons by capture, possibility of neutrons causing further fission or merely being scattered, these are questions which Harwell investigators hope to answer. Difficulties to be met with include lack of mono-energetic sources below 50 k.e.v., and the fact that the neutron, being without charge, can not be separated in the same way as charged particles, that is by a magnetic separator. The velocity of neutrons may be measured by passing them from their sources through a 650 foot tube, which is evacuated. Very short pulses are employed with this long-flight tube. As neutrons arrive at different times, their arrival is recorded. The neutron source begins with a linear accelerator to produce bursts of electrons accelerated to 25 m.e.v. Electron beams fall on a mercury target which produces x-rays as well as absorbing heat. Uranium absorbs these x-rays and produces neutrons, whose output is multiplied ten fold by making the highly enriched uranium into a subcritical U^{235} assembly. The equipment is contained in a building whose walls are six feet thick in order to give protection against the radiation produced in the course of the investigation. A flight tube with a length of 980 feet is now planned. (19)

The price of the rare isotope of helium, He^3, has been reduced from $1.50 per cubic centimeter to 15c, thus greatly increasing the number of laboratories that can do scientific experiments in the nuclear field at extremely low temperatures. Helium-3 in a refrigeration system can reduce the temperature to 0.3°K. Since it contains more protons per neutron than any other isotope, it is a unique tool for producing nuclear reactions, permitting, for example, studies in which the capture of two protons or the capture of a proton and a neutron can be directly compared. Other uses based upon particle reactions are in the fields of neutron detection and neutron spectrometry. Distribution of helium-3 from the Oak Ridge National Laboratory since the middle of 1958 has been of the order of 150,000 cc. (20)

CARBON

Sodium and potassium stirred in molten state into activated carbon have been found to produce marked increase of the adsorptive properties of the carbon, both in sepa-

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1241 Kalamazoo St., South Haven, Michigan

rating inert gases and liquid binary mixtures of aliphatic and aromatic hydrocarbons. Potassium is markedly more effective than sodium. The pore structure of carbon is regarded as being changed by the alkali metal, possibly by formation of gaps between carbon sheets, thus providing much greater surface area. Metal-activated carbon removes twice as much nitrogen from argon as ordinary charcoal. Treatment of carbon with potassium hydroxide solutions has no beneficial effect, and actually lowers adsorptive activity. (21)

Anisotropic graphite, known as Pyrographite, has directional thermal and electrical conductivities that are 1000 times greater along one plane than along another to which it is perpendicular. An illustration of this effect is the rapid melting of a piece of lead at the end of the slab being heated, while a similar lead object resting on top of this special type of graphite slab shows no signs of melting. The material so far has had some military applications in the missile field, but may find its place in nuclear reactors, electrical and microwave equipment and thermoelectric devices. Control of crystal structure has not been described, but in general the graphite is made from cracking hydrocarbons in an inert atmosphere, followed by deposition on a substrate. As an indication of the great thermal conductivity differences depending on direction of crystal orientation, the value along the surface is 200 B.t.u./hr./ft²/°F/ft., while along the vertical axis the value is lower than that of ordinary graphite. Electrical conductivity is of the same order in the two dimensions. The new material may also be made into fibers for use in thermal insulation and to reinforce plastics. (22)

The demands of the space age are resulting in the combination of graphite with refractory metals to obtain material highly resistant to elevated temperatures, and the action of nitric acid and other chemicals. Titanium vapor is employed in the impregnation of graphite, various techniques including simple vaporization, the use of a vacuum furnace, and plasma-spray methods. The titanium appears to produce titanium carbide, this being present either in a thin layer on the surface or with complete penetration until the graphite appears to be entirely titanium. Such material has a temperature resistance above 2000°F. Tungsten is also being applied to graphite surfaces with a plasma-spray without the use of expensive undercoatings, of which rhenium is typical. The tungsten-coated graphite is said to resist flame temperatures around 5500°F and pressures of 500-1000 psi. (23)

PLASTICS

Electrical resistivity has been found by Navy investigators (NOL) to be an excellent tool for study of the kinetics of the polymerization reaction and the structure of the polymerized resin, particularly those of the thermosetting type. This method was employed to follow the course of a series of bulk isothermal polymerizations of diallyl phthalate catalyzed with benzoyl peroxide. By taking the time rate of change of the logarithm of the resistivity, which is temperature dependent, as an index of the rate of polymerization, the overall activation energy for the polymerization was calculated. (24)

Temperature-resistant polymers of a semiorganic type are being developed for the Air Force (WADC). These are of three types, one of which is particularly adapted to functioning as structural adhesives. Such adhesives for bonding metal to metal depend on the reaction between phosphorus oxychloride, and more commonly phosphorus pentachloride, with organic nitrogen compounds of the melamine or hydrazide type. Epoxy resins also were found curable without external heat by use of phosphorus pentoxide. Polymers containing the benzotetraäzaporphin structure were best prepared in some cases by use of metal alkoxides, while others were made from purely organic nitrogen compounds. Copper cyanines and porphins were unaffected by exposure to radiations from a cobalt-60 source, and the porphins were stable in a vacuum to 530°C, but decomposed below 700°C. A third type, classed as semiorganic, were based on an aluminum-oxygen system, being aluminum chelates containing aromatic radicals attached to short aliphatic chains in which oxygen is present, while others also contain silicon. A quadrivalent aluminum monomer was a chelate, which melted at 324°C without decomposition. Resistance to hydrolysis and oxidation and stability to around 480°C appear to be goals of this research on inorganic polymer systems containing both aluminum and silicon. (25)

Laminated transparent aircraft enclosures may be satisfactorily replaced by monolayer stretched acrylic plastic sheet materials. These plastics, conforming to standard specifications, were stretched biaxially and multiaxially and aged under several conditions. No differences were found between these two methods of stretching. One plastic which was stretched 75% equally in two directions showed the best properties before and after aging. All stretched materials were better than unstretched in resistance to crazing, impact strength, and notch sensitivity, but were inferior in resistance to abrasion. The work in this field was done for the Air Force (WADC) by commercial contractors. (26)

Photopolymer printing plates are expected to go into large-scale commercial production with the erection of a unit capable of producing one milion sq.ft. per year of these plates. The nature of the polymer has not yet been announced, except that a thin layer of plastic monomer is bonded to underlying metal. When a photographic negative of the high-contrast type is placed over the plastic-covered plate and exposure is carried out to ultraviolet light from a carbon arc, the plastic hardens where the light strikes. The unexposed portions are still soft, and may be washed away with a high-pressure water spray containing less than 15% of sodium hydroxide. The time required to make a plate and get it on a printing press is of the order of 15 to 20 minutes. (27)

Manufacturers of delicate instruments and equipment are guided in preparing their own cushioning material for packaging, shipping and storing such items by Air Force specialists in the field of foamed-in-place polyurethane plastics. Premolding or a combination of premolding and foaming into the container are said to represent the best techniques. Storage of the materials from which cushioning plastics are made requires only about 5% of the space that is needed for such fabricated supplies as curled hair. These polymeric materials are relatively cheap, and techniques of foaming operations are said to be simple. (28)

PETROLEUM PRODUCTS

The fuel resources of Canada and the entire North American Continent would be greatly increased if it were possible to extract the heavy hydrocarbons of the Athabasca sands in northern Alberta. The viscosity of this material is the obstacle in the way of making use of this great resource. Some proposals have been made to utilize atomic energy to break down the viscosity of the heavy hydrocarbons and obtain products resembling

(Continued on page 28)

DEPOSITION OF AEROSOLS ON CLOTHING AT LOW WIND SPEEDS

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INTRODUCTION

The theory of particulate impaction has been considered by Albrecht (1), Glauert (2), Landahl and Herrmann (3), Langmuir and Blodgett (4), Ranz and Wong (5), and Sell (6). They computed particle trajectories and obtained percentage efficiency of impaction on cylinders and other objects. These investigators concluded that the efficiency of deposition increased with an impaction parameter, K, which is dependent on (a) density and diameter of the aerosol, (b) velocity and viscosity of air, and (c) diameter of object.

Few quantitative studies have been done on inertial impaction. Landahl (7) showed that deposition of dibutyl phthalate aerosol was greater on human arms than on brass or celluloid. Landahl and Herrmann (3) and Ranz and Wong (5) determined the efficiency of impaction of aerosols on fine wires and glass rods. Asset and Pury (8) studied the impaction of triphenyl phosphate aerosol on human arms at low wind speeds. They concluded that particles exceeding six microns in size are required for significant deposition on arms. They were unable to detect any deposition with one micron particles at two mph.

In order to evaluate aerosol hazard it is essential to know to what extent air-borne particulates will deposit, at various wind speeds, on clothing materials. It is the purpose of this report to present such data.

APPARATUS AND METHODS

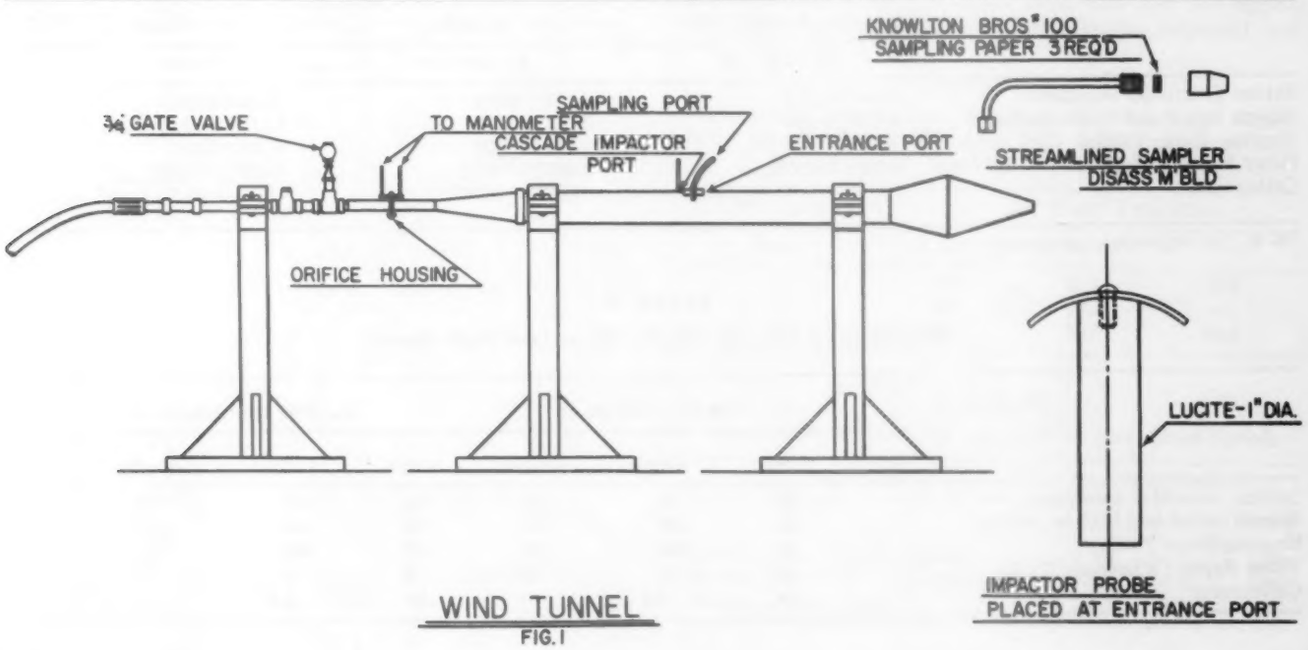
A small laboratory wind tunnel, Figure 1, was used for the exposures. It was about 15 feet in length with a working section 5 feet long and 4 inches in diameter. At a point 4 feet from the intake of the tunnel a 2½" by 2½" opening was provided. In the center of the cover for this opening, a lucite cylinder (4" long and 1" diameter) was mounted. On this cylinder the cloth to be studied was fixed. Wind velocities were measured manometrically on the downwind side of the tunnel.

The test aerosol consisted of a 10% solution of fluorescein in ethylene glycol dispersed by an aspirator described by Laskin (9). The resulting aerosol entered a spherical globe which removed the large particles and allowed the aerosol to mix with the intake air of the tunnel.

Particle size measurements were made before the experiment proper by means of a cascade impactor. The mass median diameter (MMD) remained at 1 micron for each exposure. However, the value below which 95% of the mass was concentrated fluctuated somewhat. Only the MMD is reported and used in computations involving particle size because this quantity can be quickly determined.

Air samples were collected by means of a streamlined filter paper sampler placed about 6 inches upstream from the impaction cylinder. The sampler was operated isokinetically during the entire exposure. The material collected in the filter paper sampler was read directly in a Farrand Fluorometer. Weights and concentrations refer to the total weight (fluorescein plus ethylene glycol).

Thirty exposures of each material were made in the wind tunnel at various wind speeds and exposure times. The material being studied was fixed to the cylinder.



WIND TUNNEL
FIG. 1

Recovery of the deposited aerosol was made by cutting a 10 sq. cm. portion from the cloth on the upstream side and extracting the fluorescein-ethylene glycol with water. The following materials were exposed at wind speeds of 1, 4 and 6 mph for time periods ranging from 5 to 30 minutes:

1. Sateen cloth cotton, 8.5 oz. Non-water repellent.
2. Sateen cloth cotton, 9 oz. Wind and water repellent.
3. Herring-Bone Twill.
4. Filter paper, Whatman No. 2.

Cellophane was exposed at a wind speed of 4 mph.

To evaluate the protection that such clothing might afford against aerosols, these clothes were backed by filter paper on the cylinder so that penetration could be measured.

RESULTS

Impaction Efficiency

Table I shows the impaction efficiency of ethylene glycol aerosol on these materials at various wind speeds. It is evident from Table I that in terms of per cent efficiency deposition is of a low order.

Deposition vs. Concentration and Time

Figures 2, 3, 4 and 5 show the relationship of concentration and time (mg min/cu m) with the amount of aerosol deposited per unit area (mg/sq m) on the materials, sateen (non-water repellent), sateen (wind and water repellent), herring-bone twill, and filter paper (Whatman No. 2). It is evident from these data that there is a marked difference in deposition of the aerosol with atmospheric concentration and wind speed. These data are summarized in Table II for Ct's of 1000 and 5000 mg min/cu m.

Table III shows the relationship of deposition on the front, sides and back of sateen (non-water repllent) cloth at various wind speeds. It is evident from these data that the aerosol deposited on the cylinder increases on the front and decreases on the sides with increasing wind speed.

Penetration

Table IV shows the relationship between wind speed and penetration for each cloth used in these studies.

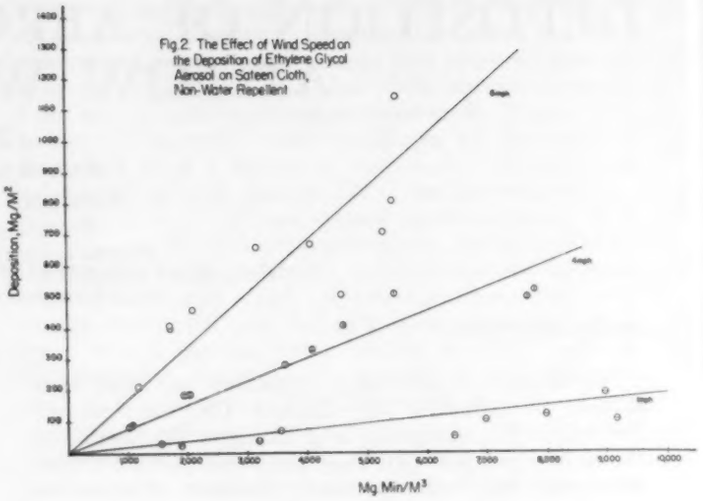


Fig. 2. The Effect of Wind Speed on the Deposition of Ethylene Glycol Aerosol on Sateen Cloth, Non-Water Repellent

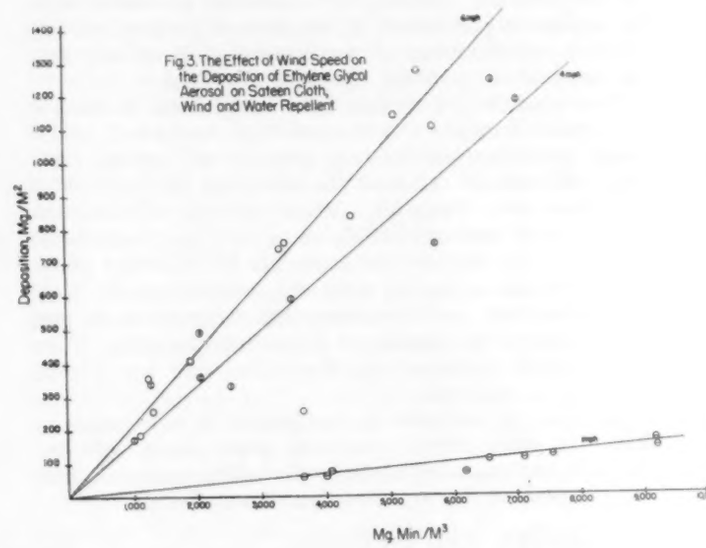


Fig. 3. The Effect of Wind Speed on the Deposition of Ethylene Glycol Aerosol on Sateen Cloth, Wind and Water Repellent

TABLE I

Impaction Efficiency of Aerosols at Low Wind Speeds

	Per Cent Efficiency		
	1 mph	4 mph	6 mph
	*K=1.4×10⁻⁴	K=2.8×10⁻⁴	K=6.0×10⁻⁴
Sateen (non-H_2O repellent)	0.044±0.011	0.155±0.013	0.110±0.021
Sateen (wind and H_2O repellent)	0.056±0.009	0.163±0.043	0.119±0.016
Herring-Bone Twill	0.033±0.006	0.114±0.018	0.104±0.010
Filter Paper (Whatman No. 2)	0.0025±0.0002	0.0087±0.0001	0.0102±0.0031
Cellophane	———	0.00022±0.00003	———

*K is the impaction parameter

TABLE II

Deposition of Aerosols (Mg/Cu M) at Low Wind Speeds

	Ct, 1000 mg min/cu m			Ct, 5000 mg min/cu m		
	1 mph	4 mph	6 mph	1 mph	4 mph	6 mph
Sateen (non-H_2O repellent)	18	76	164	91	378	822
Sateen (wind and H_2O repellent)	16	197	212	79	820	1059
Herring-Bone Twill	8	126	185	42	632	924
Filter Paper (Whatman No. 2)	1	10	16	4	48	82
Cellophane	—	0.3	—	—	1.3	—

These data show that sateen (wind and water repellent) cloth offers the best protection against the penetration of aerosols at wind speeds between one and 6 mph. The sateen (non-water repellent) offers better protection at one mph than it does at 6 mph, while the herring-bone twill is better at 6 than at 1 mph.

DISCUSSION

It has been found experimentally that impaction efficiency is a function of an impaction parameter, K, and increases with it. Theoretically, there is a value of K below which inertial impaction does not occur if the particles are small relative to the size of the object. This critical value of K was computed by Taylor (10) to be 0.0625 for a cylindrical object. Although the values of K (1.4×10^{-4} to 6.0×10^{-4}) obtained in these experiments are smaller than the computed critical value, measurable impaction did occur. Landahl and Herrmann (3) and Asset and Pury (8) also showed that impaction occurred below this critical value.

The results of this study show that impaction efficiency increases significantly with wind speed change from one to 4 mph. (Table I). There are no significant differences in efficiency in the change from 4 to 6 mph. This may be due to the pressure exerted at the higher wind speed on the extended fibers of the materials in such a manner as to make the exposed surface smoother.

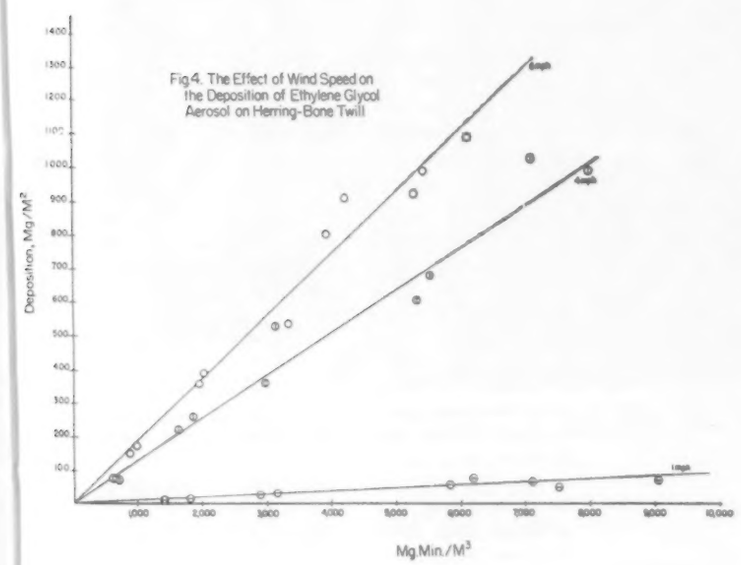


Fig.4. The Effect of Wind Speed on the Deposition of Ethylene Glycol Aerosol on Herring-Bone Twill
Deposition, Mg/M²
Mg.Min./M³

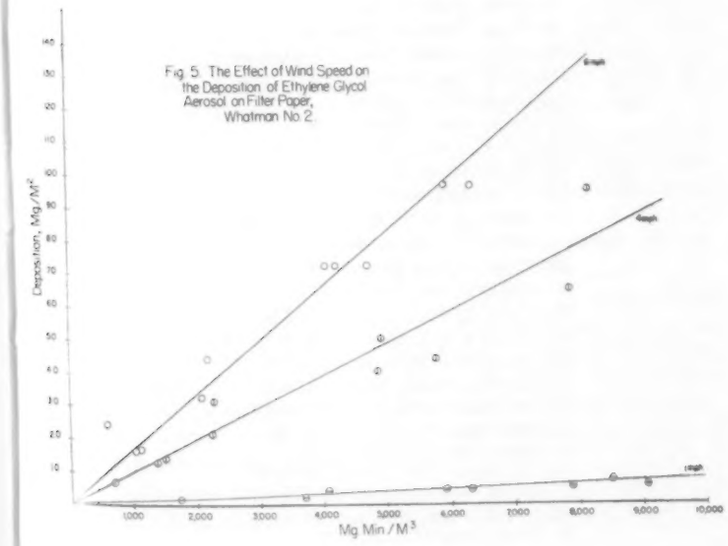


Fig. 5. The Effect of Wind Speed on the Deposition of Ethylene Glycol Aerosol on Filter Paper, Whatman No. 2.
Deposition, Mg/M²
Mg. Min. / M³

Figure 6

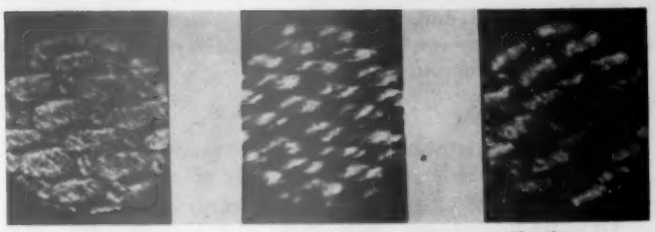


Figure 6 shows microscopic photographs of the three types of cloth used in this study. Apparently the flattening of the fibers does not occur until a critical wind speed (pressure) is reached. This value is probably dependent on the relative strength of each materials.

The results summarized in Table II (4 mph) show that there is a definite difference in the amount of aerosol deposited from one material to another at a given air-borne concentration. At one extreme, cellophane, the smoothest material, had a deposit of but 0.3 mg/sq m; while at the other extreme, sateen (wind and water repellent) had a deposit of 197 mg/sq m. The data recorded in Figures 2, 3, 4 and 5 show that there is a linear relationship between the amount of aerosol deposited and the air-borne concentrations employed in this study.

While these data indicate that impaction efficiency is of a low order at low wind speeds, they point out that the actual amount of aerosol deposited can be significant.

Of the total amount of deposition around the sampling cylinder, it was found that the deposit on the windward side increased from about 40% to 50% with increasing wind speed. These data are in fairly good agreement with those of Landahl (7) who found that 38% of the total deposition on a celluloid cylinder was on the windward side.

Of the three cloths employed in this study, it was found that sateen (wind and water repellent) afforded the best overall protection against the penetration of air-borne particulates. Of the two other cloths, it was found that sateen (non-water repellent) was about twice as effective at 1 mph as it was at 6 mph, while the behavior of herring-bone twill was just the opposite. Examination of these materials under reflected and

TABLE III

Deposition of Aerosols on Sateen Cloth (Non-Water Repellent) Surrounding Probe, One Inch in Diameter, at Low Wind Speeds

Wind Speed	Per Cent Deposition		
mph	Front	Sides	Back
1	40.7	52.4	6.9
4	45.5	48.2	6.3
6	49.8	39.6	10.6

TABLE IV

Penetration of Cloth by Aerosols at Low Wind Speeds

Material	Per Cent Penetration		
	1 mph	4 mph	6 mph
Sateen (non-H_2O repellent)	0.49	0.71	1.15
Sateen (wind and H_2O repellent)	0.54	0.32	0.45
Herring-Bone Twill	1.32	0.64	0.81

transmitted light revealed that the porosity of the sateen (wind and water repellent) was less than that of sateen (non-water repellent) which in turn was less than that of herring-bone twill.

SUMMARY

Experiments were conducted to study the effect of low wind speeds on the deposition of one-micron air-borne ethylene glycol particulates on several types of clothing materials.

A small laboratory wind tunnel was constructed to conduct the deposition experiments.

The deposition of air-borne particulates (ethylene glycol containing 10% fluorescein) about one-micron in diameter on sateen (non-water repellent), sateen (wind and water repellent), and herring-bone twill at 1 mph is of the order of 0.05% at 4 or 6 mph 0.10 to 0.15%.

The deposition of one-micron air-borne particulates on a surface is dependent on Ct (mg min/cu m), roughness of the surface, and wind speed.

The penetration of one-micron air-borne particulates through sateen and herring-bone twill cloth is of the order of 0.5 to 1.5% at low wind speeds and is dependent on the porosity of the materials.

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(Continued on page 32)

DEFENSE CHEMISTRY IN THE NEWS

(Continued from page 24)

those of petroleum. A large research project is now under way, supported by four large oil companies. A strip-mining machine is to work its way, and is accompanied by a portable, self-propelled unit. A liquid derived from processing the bitumen is employed as a diluent. Water is recovered from the diluted bitumen, and is recycled in the process. The diluent is separated by flash distillation, and the bitumen remaining is split into fuel and feed for a thermal cracking unit in which its viscosity is broken. Products are diluent, overhead naphtha, bitumen, and viscosity-breaker liquid. Hydrogenation techniques are expected to convert the high-viscosity, high-sulfur bitumen into a low-sulfur crude which is salable. (29)

The two major offenders in automobile gases which are listed as the causes of smog are nitrogen oxides and unburned hydrocarbons. Nitrogen oxides may be oxidized along with carbon monoxide in the exhaust by the promotion of such reactions by chromite catalysts, these being largely zinc-copper chromite, iron chromite, and certain promoted chromites and oxides. If sufficient oxygen is present, the same catalysts may also promote the oxidation of the excess hydrocarbons. The catalysts will probably eliminate the use of auxiliary pumps to add air for oxidation. The hydrocarbon part of the problem is being attacked in another way by continuous injection of a lean fuel-air mixture (air-fuel ratio of 30:1). Unburned hydrocarbons are reduced from 5% to 2% of the original fuel weight. A small pre-combustion chamber is located in the sparkplug well. When the operating load is light, fuel and air are introduced to the precombustion chamber, and the mixture is exploded as usual by the sparkplug. As the load increases, additional fuel by-passes the chamber and goes into the engine cylinder. The system is credited with a two-third reduction of exhaust hydrocarbons as well as an increase of 15% in fuel economy. (30)

Normal hexane is the new solvent for tributyl phosphate by which uranium is recovered from uranyl nitrate solution, which is in turn produced from digesting ore concentrates. The specific gravity of 0.69 of *n*-hexane enables it to handle tributyl phosphate (sp.gr. 0.98) to the extent of 50% with no loss in efficient mass transfer and phase separation. The feed in the pilot plant process is a clear solution of uranyl nitrate of 200 grams per liter instead of the usual slurry, so that throughput is increased to 96 g./hr./sq.ft. A special "pumper decanter" which provides high solvent to aqueous solution ratios at the point of contact has overcome the tendency to emulsify. This equipment may be used with slurries in full-scale processes now in use. Because of the low density of hexane, the throughput is increased three fold in the step in which impurities are washed from the solvent in columns whose perforations are larger than those handling kerosene solutions. Water removes uranyl nitrate from the solvent stream, after which hexane is recovered in a steam-heated evaporator. The uranyl nitrate solution is concentrated and separated as a mixture of hydrates. Denitration results in uranium trioxide. The remaining process is the same as in other AEC plants. (31)

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1) Chem. Eng. 12/14/59, p. 194
2) Chem. & Eng. News 1/18/60, p. 50
3) Chem. Eng. 11/2/59, p. 118
4) Chem. & Eng. News 1/25/60, p. 55
5) Chem. & Eng. News 11/30/59, p. 62
6) Chem. Week 11/21/59, p. 166
7) Chem. Week 12/19/59, p. 68
8) Chem. Week 11/28/59, p. 89
9) Chem. Eng. 12/28/59, p. 34
10) Chem. & Eng. News 1/11/60, p. 62
11) Chem. Eng. 11/16/59, p. 178
12) Chem. Week 1/23/60, p. 25
13) Chem. Eng. 1/25/60, p. 86
14) Chem. & Eng. News 12/28/59, p. 42
15) Chem. Week 12/12/59, p. 76
16) Chem. Eng. 12/28/59, p. 40
17) Off. Tech. Serv. 59-397, 12/21/59
18) Off Tech. Serv. 59-385, 12/15/59
19) Chem. & Eng. News 11/30/59, p. 44
20) Oak Rdg. Nat. Lab. 1/19/60
21) Chem. & Eng. News 1/11/60, p. 38
22) Chem. & Eng. News 11/30/59, p. 56
23) Chem. Eng. 12/28/59, p. 24
24) Off. Tech. Serv. 60-14, 1/12/60
25) Off. Tech. Serv. 59-404, 12/24/59
26) Off. Tech. Serv. 60-14, 1/12/60
27) Chem. Week 1/23/60, p. 65
28) Off. Tech. Serv. 59-386, 12/16/59
29) Chem. Week 1/23/60, p. 65
30) Chem. Week 12/5/59, p. 69
31) Chem. Eng. 11/2/59, p. 28

WITH THE CHEMICAL CORPS

Maj. Gen. Marshall Stubbs, center, luncheon guest at First Army Hqrs., Governors Island, N. Y. At left of picture, Maj. Gen. J. F. R. Seitz, First Army Chief of Staff; right, Colonel T. P. Gahan, First Army Chemical Officer.

CHIEF CHEMICAL OFFICER VISITS GOVERNORS ISLAND

Major General Marshall Stubbs, Army Chief Chemical Officer, spent January 21 at First U. S. Army Headquarters, Governors Island, N. Y., conferring with more than 30 Chemical Corps officers and members of the Chemical Corps Reserve of the First Army area.

During his visit General Stubbs inspected the First Army CBR Team. This team, First Army Hqs. states, is ready at all times for immediate dispatch to the scene of any incident involving CBR hazards. The team carries all equipment needed for decontamination, detection, protective, and rescue measures.

Major General J. F. R. Seitz, Chief of Staff, First Army, and Colonel T. P. Gahan, First Army Chemical Officer, were hosts at a luncheon for General Stubbs and the group of conferees at the Fort Jay Officers Club. The luncheon was followed by briefings on Chemical Corps requirements for First Army area planned maneuvers and field exercises.

General Stubbs addressed the Chlorine Institute at the Hotel Commodore January 20, and concluded his visit to New York as the dinner guest of the Chloral-Alkali Association Executives at the Cloud Club in the Chrysler Building, January 21.

COL. GREENE'S POST IN HAWAII WAS ON THE CINCPAC JOINT STAFF

The last previous assignment of Col. William H. Greene before his recent appointment as Commandant of the U.S. Army Chemical Corps School, Fort McClellan, Ala., was Chief, Logistics-Plans Branch of the CINCPAC Joint Staff in Hawaii, not that of Chemical Officer, Headquarters, U.S. Army Pacific.

The item concerning Colonel Greene's new appointment in the January-February issue of THE JOURNAL (p. 38) was in error in stating that Col. Carl V. Burke, whom Colonel Greene replaced as the School Commandant, in turn had replaced Colonel Greene in his last previous assignment in Hawaii. Colonel Burke's new assignment in Hawaii is Chemical Officer, Headquarters, U.S. Army Pacific.

COL. MEETZE, NEW DEPUTY CHIEF CHEMICAL OFFICER

Col. Adam W. Meetze has been appointed Deputy Chief Chemical Officer of the Army, filling the post vacated by Brig. Gen. William E. R. Sullivan, who is now President of the Chemical Corps Board. Colonel Meetze was serving with the Weapons System Evaluation Group, Office of the Secretary of Defense.

Born in Leesville, South Carolina, October 23, 1908, Colonel Meetze has a BS degree in chemistry from Clemson College. He served as an industrial chemist for 10 years before entering the Army in 1940.

In World War II Colonel Meetze served as Chief of Arsenal Operations at Edgewood Arsenal, Maryland, later as chemical officer, Headquarters, IV Army Corps in Europe.

Assignments since the war have included Commanding Officer Rocky Mountain Arsenal; service with U.S. Army Communications Zone in Europe, and duty in Lebanon during the crisis there.

COLONEL MERRILL TO KOREA

Col. Claude Merrill, who has been chief of the Personnel Division in the Office of the Chief Chemical Officer, has been assigned to a Logistics position in Korea in the United Nations Command, on the staff of General Magruder. Colonel Merrill's replacement as chief of the Personnel Division is Col. Vincent F. La Piana.

MR. HORMATS IS APPOINTED DIRECTOR OF DEVELOPMENT

Mr. Saul Hormats has been appointed as the Chemical Warfare Laboratories' director of development at Army Chemical Center, Maryland. He has been acting in that capacity since late July.

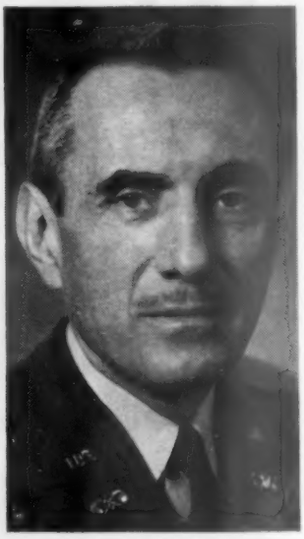
The first civilian to be appointed to this key position, the Army Chemical Center states he will be responsible for the development of all chemical warfare munitions and defense devices for the United States.

A 1931 graduate of John Hopkins University, Mr. Hormats has been employed at the Chemical Center for the past 28 years. He is a Lieutenant Colonel in the Active Reserve.

COMMAND CHANGES IN THREE OF FOUR MAJOR COMMANDS

EDGEWOOD, MD., Jan. 21.—Three of the Chemical Corps' four major commands got new bosses and Army Chemical Center got a new post commander last week

GEN. ESSMAN



COL. DELMORE

in one of the Corps' biggest changes in recent years.

Brig. Gen. Graydon C. Essman, commander of the Research and Development Command since 1957, took over Tuesday (Jan. 19) as head of the Materiel Command and as Army Chemical Center post commander.

Col. Roy W. Muth, who has been in the dual command post since the retirement of Brig. Gen. Harold Walmsley last September, returns to head the Engineering Command, the job he left in the fall.

Col. Fred J. Delmore will replace General Essman in the Washington, D.C., research and development post.

Colonel Delmore was recently replaced as president of the Chemical Corps Board by Brig. Gen. William E. R. Sullivan, formerly Deputy Chief Chemical Officer.

Mr. Leo F. Walsh, Logistics Planning Div., congratulated by Maj Gen Marshall Stubbs upon receiving the Meritorious Civilian Service Award of the Department of the Army.

CHANGES AT McCLELLAN

At the U. S. Army Chemical Corps Training Command, Fort McClellan, Alabama, Colonel Carl W. Bartling has been reassigned to the post of assistant commandant, Chemical Corps School. Lt. Colonel Roger W. Kemp has assumed Colonel Bartling's former post as commanding officer of the 100th Chemical Group, with Major Francis A. Bader replacing Colonel Kemp as commanding officer of the 83rd Chemical Battalion. Major Bader recently returned from Fort Bragg, N. C., where he had been serving on the staff of the maneuver director for Exercise Dragonhead.

FELLOWSHIP FOR STUDY OF SPACE FOOD PROBLEMS

Mr. Clark Cottrell, Jr., resident engineer at Pine Bluff Arsenal, Arkansas, of the Army Chemical Corps Engineering Command, has been awarded an Army Research and Study Fellowship at the University of California, Berkeley.

Presentation of the award was recently made by Colonel Russell W. Dodds, commanding officer at Pine Bluff, in ceremonies in his office. Mr. Cottrell's wife and two sons accompanied him.

Mr. Cottrell, formerly employed at Biological Warfare Research Center at Fort Detrick, Maryland, will devote his time in this new assignment to engineering, scientific and biochemical studies pertaining to the supply of food and maintenance of biochemical balance for personnel within a space vehicle during long-range flights, or extended stays on planets which are not suitable to human habitation, according to statement released by Pine Bluff.

Mr. Cottrell has Bachelor and Masters degrees from the University of Michigan.

SPEAKS AT LEAVENWORTH

Maj. General Marshall Stubbs, Chief Chemical Officer of the Department of the Army, recently addressed the U. S. Army Command and General Staff College, Fort Leavenworth, Kansas, on "New Developments in Chemical Corps Materiel.

Maj. General Lionel C. McGarr (right), Commandant of the Staff College, is shown with General Stubbs in the picture below.

GEN. SAYRE GUEST SPEAKER AT CHEMICAL CORPS SCHOOL

Brig. General Clifford L. Sayre, president of The Armed Forces Chemical Association, who recently retired from the Army Reserve, was the guest speaker at the graduation ceremonies of the U. S. Army Chemical Corps School's First Chemical Officer Class at Fort McClellan, Alabama, on 5 December 1959.

Speaking as a soldier, General Sayre named some of the great military leaders—such as Washington, Upton, Scott, and Pershing—who were responsible for molding the Army into the effective fighting force of today. Then speaking from his role as Director of Engineering of the Chemical Division of the Food Machinery and Chemical Corporation, he emphasized "that a young man should always perform all tasks assigned him because sooner or later even the undesirable tasks performed will pay dividends." Lastly, as President of A.F.C.A., he outlined the purpose of the Association and asked that the graduates support and help in fulfilling the Association's mission.

While serving for more than 35 years as a reserve officer, General Sayre was on active duty during the First and Second World Wars and the Korean Conflict. He received the Legion of Merit for his outstanding work in World War II. During the Korean War, he was recalled to active duty to serve as commanding officer of the Engineering Agency, Army Chemical Center, Maryland.

General Sayre is also a member of the Reserve Officers Association, American Institute of Chemical Engineers, and the American Society of Naval Engineers.

Colonel John M. Palmer, Commanding Officer, Chemical Corps Training Command, introduced General Sayre.

FORT McCLELLAN, ALABAMA, Brig. Gen. Clifford L. Sayre, President of the Armed Forces Chemical Association, second from right, and Col. John M. Palmer, Commanding Officer, U. S. Army Chemical Corps Training Command, second from left, were guests at a reception held at the Officers' Club to honor the outgoing 100th Chemical Group Commander, Col. Carl W. Bartling, right, and Lt. Col. Roger W. Kemp (left), new Group Commander.

Mr. David A. Rosenfeld, a Chemical Corps standardization authority, was honored recently for becoming the 1000th member of the Standards Engineers Society at a meeting of the society at Anacostia Naval Air Station.

Mr. Rosenfeld is chief of cataloguing and standardization of the Engineering Command.

AWARDS

Information has been received by THE JOURNAL of the following awards to Chemical Corps personnel:

OFFICE CHIEF CHEMICAL OFFICER, WASHINGTON, D. C.

MERITORIOUS CIVILIAN SERVICE

Owen R. Mullen, Logistics Planning Division
Leo F. Walsh, Logistics Planning Division

SPECIAL SERVICES (cash award)

Delbert H. Flint, Personnel Division

SUSTAINED SUPERIOR PERFORMANCE

Anthony J. Caiozzo, William J. Ellenberger, Donald E. Grant, Robert W. Plummer, Glen I. Rhorer, Harold J. Valis, and Charles D. Yeffman (Logistics Planning Division); James W. Strother and Mrs. Esther Williams (O/Comptroller)

OUTSTANDING PERFORMANCE APPRAISAL

James W. Hepburn and Leo J. Holland (Personnel Division)

CERTIFICATE OF ACHIEVEMENT

Marion I. Hinson, Edgar R. McDaniel, Eleanor G. Shaw (Logistics Planning Division)

TWENTY-YEAR SERVICE

Richard S. Fanske and J. James Wenstrup, (Personnel Division)

U. S. ARMY CHEMICAL PROCUREMENT DISTRICT, NEW YORK

BENEFICIAL IDEA FOR OPERATIONS (Certificate and Cash)

Cecil M. Bynoe

BENEFICIAL IDEA FOR SAFETY (Certificate and Cash)

Cecil M. Bynoe, Annette E. Mason, and Cynthis I. Trotman.

SUSTAINED SUPERIOR PERFORMANCE

Max Negler

U. S. ARMY CHEMICAL CORPS DISTRICT, CHICAGO*

TWENTY OR MORE YEARS OF SERVICE

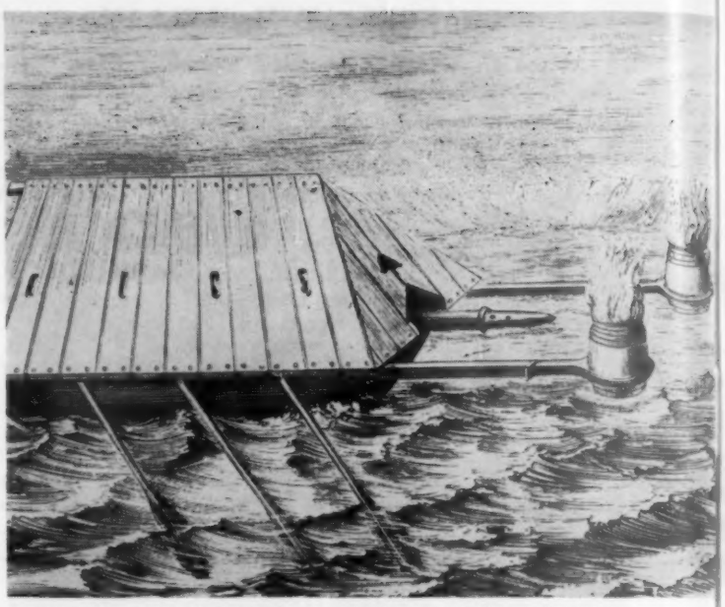
Irving Bernstein, Florence E. Broderick, Harold C. Elliott, Donald J. Gleason, Dorothy E. May, and Maria B. Tesseyman.

TEN OR MORE YEARS OF SERVICE

John E. Axford, Helen E. Bookout, John L. Brink, Mary E. Corrigan, Julius L. Dawson, Elmer E. Frederick, Miles J. Glover, Michael Kienzynski, Charles H. Love, Mary L. Noell, Anthony L. Peruzzo, Esther B. Ritter, Edward A. Roach, Bruno J. Sarocka, E. Gertrude Scott, Hortense B. Shockley, Maurice Washer, and Morris Winer.

*These awards were made early in 1959.

The family of Mr. Owen R. Mullen turns out to see him receive the Meritorious Civilian Service award from Maj Gen Marshall Stubbs, Chief Chemical Officer, Washington, D. C., Dec. 21, 1959.



ARMORED FIRE SHIP, possibly found in the Mediterranean area during the Middle Ages, was oar-propelled, used to set fire to enemy ships.

CHEMICAL WARFARE IN HISTORY

(Continued from page 17)

John W. Doughty of New York, who recommended the use of chlorine-filled artillery shells.

The use of smoke to screen military operations from enemy view, accepted as practical in the major wars of the twentieth century, probably evolved from the dust clouds raised by cavalry horses in early times.

Ramayana, in his writings of about 2000 B.C., described what sounds to be a smokescreen:

> "And clouding the whole sky with smoke that effulgent one . . . hid himself from their gaze. And in that terrible darkness of clouds, began to make a downpour of arrows. . . ."

As early as 50 B.C., smoke from burning wet straw was used to hide troop movements, and in the 17th century, Gustavus Adolphus employed the same technique to cover his crossing of the Lech during the Thirty Years War.

In 1864, President Lincoln turned down a suggestion to use smoke for concealment of troops. However, Confederate blockade runners used smoke throughout the war to hide their movements from the Union Navy. The smoke was produced by burning pine wood, rich in resin and pitch, in the ships' boilers.

DEPOSITION OF AEROSOLS

(Continued from page 28)

Fortsch Geibiete Ingenicurw. Hcft 347. Translated by J. P. Demoter in AEC Contract AT (30-3)-28 Report S01004.

7. Landahl, H. P. 1944. UCTL Informal Report 9-4-1-23, Dec. 1944, p. 6.

8. Asset, G. and D. Pury. 1954. Deposition of windborne particles on human skin. A.M.A. Arch. Ind. Hyg. and Occup. Med. 9:273.

9. Laskin, S. 1948. Submerged Aerosol Unit. University of Rochester, AEC Project, quarterly Report UR-38.

10. Taylor, G. I. 1940. Notes on possible equipment and technique for experiments on icing on aircraft. AER Res Comm R&M 2024.

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